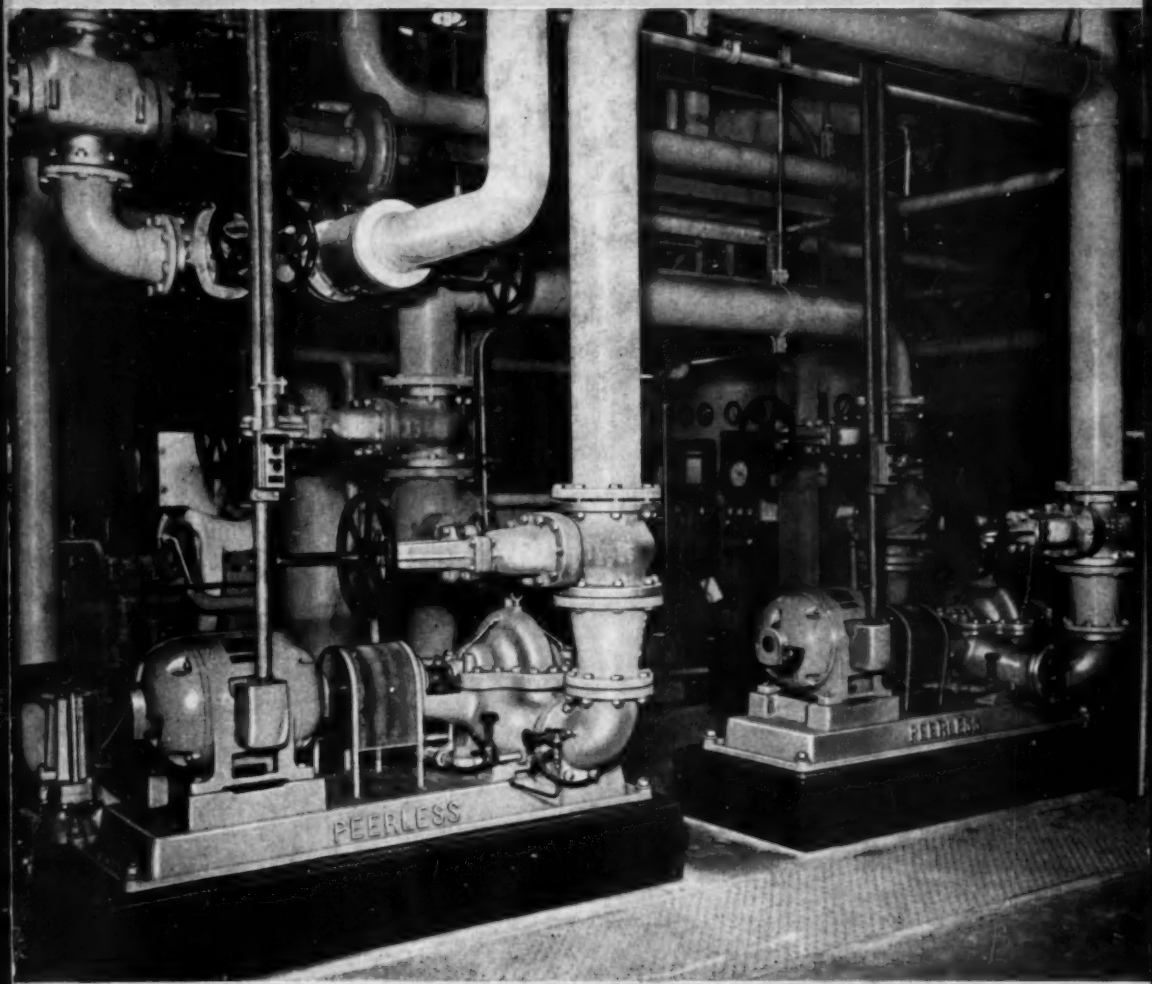
INDUSTRY AND POWER

For Executives and Engineers Responsible For Engineered Plant Services



SPECIAL REPORT ON AIR POLLUTION

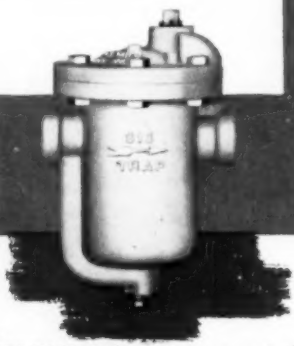
JANUARY 1952

Celanese Expands Steam Generating Facilities ..... Page 61

Cross-Fired Spreader Stokers ..... Page 64

THE EVIDENCE IS OVERWHELMING!

ARMSTRONG TRAPS
GIVE UNEQUALLED RESULTS



NEED FOR NEW BOILER ELIMINATED after installing Armstrong traps on canning equipment . . . *Bestovall Canning Co., Vancouver, B. C.*

50% DECREASE IN HEAT-UP TIME of plating coils . . . *Proctor Electric Co., Philadelphia, Pa.*

15% GREATER PRODUCTION since unit trapping with Armstrongs . . . *Sun Ray Cleaners, Chicago, Ill.*

NO REPAIRS IN SIX YEARS ON 250 Armstrong traps . . . *Plymouth Shoe Co., Middleboro, Mass.*

20% FUEL SAVINGS after trapping heating coils individually . . . *Norton Greenhouses, St. Paul, Minn.*

SAVING 14 TONS COAL PER MONTH with Armstrong traps . . . *M. Wile & Company, Buffalo, N.Y.*

30% LESS MAINTENANCE on traps on low pressure heating system . . . *John Deere Harvester Works, East Moline, Ill.*

BETTER QUALITY WORK since trapping laundry equipment with Armstrongs . . . *Soft Water Laundry & Cleaners, Long Beach, Cal.*

40° HIGHER TEMPERATURES in flatwork ironer rolls . . . *Peter Bent Brigham Hospital, Boston, Mass.*

40 MINUTES FASTER HEAT-UP in drying oven since Armstrong traps were installed . . . *Emerson Drug Co., Baltimore, Md.*

DRIER HEAT-UP TIME CUT 2-3 HOURS with six Armstrong traps . . . *Industrial Grain Products, Fort Williams, Ontario.*

SAVES 3728 GALLONS FUEL OIL first year Armstrong traps were installed . . . *Mary Lincoln Candies, Buffalo, New York.*

YOU CAN confidently *expect* results like those listed at the left when you install Armstrong steam traps because:

- No steam loss, hence steam and fuel savings and less return line back pressure.
- Air is vented automatically along with condensate, assuring maximum temperature, less corrosion.
- Valve and seat are chrome steel, hardened, ground and lapped—good for temperatures to 900° F, 950 psig, they last for a long, long time at lower pressures.
- Valve lever assembly and bucket are 18-8 stainless for long wear and corrosion resistance.
- Nothing to stick, clog, leak or collapse.
- Dirt is washed right through by swirling action of the condensate.
- There is almost no friction between moving parts.
- The valve is either wide open or tight closed—no wire-drawing, no dribbling, less wear.
- Condensate is discharged at steam temperature, keeping units at top temperature.

Why have less? Order your Armstrong traps now.

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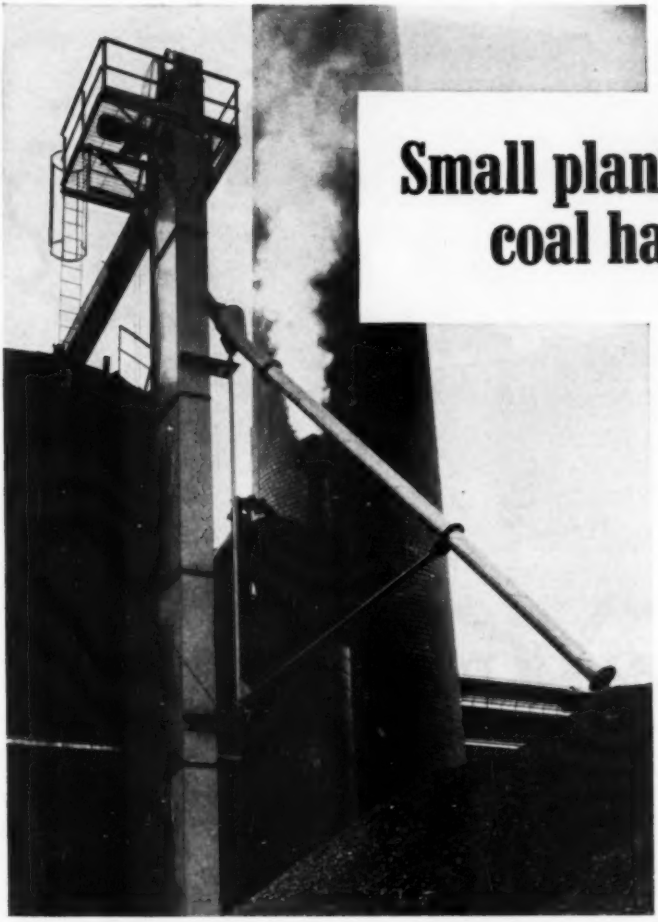
SEND FOR THE 36-PAGE STEAM TRAP BOOK FOR COMPLETE DETAILS

ARMSTRONG STEAM TRAPS



Small plants, too, slash coal handling costs

LINK-BELT engineering and equipment provide "big-plant" efficiency

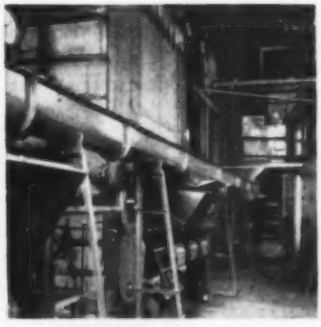
Whether you handle one ton or 2000 tons of coal per hour, Link-Belt builds equipment to match your requirements. As in the power plant shown here, Link-Belt offers you all the latest advances in coal handling equipment.

Our engineers will work with you and your engineers from design stage to finished structure, selecting the proper equipment for your plant. Result: lower cost per ton handled.

Link-Belt coal handling equipment at this plant delivers coal from railroad car to storage to boiler. L-B Bucket Elevator discharges to silo and also handles coal to and from reserve ground storage.

Bar Flight Feeder handles coal from track hopper to bucket elevator at capacity rate of 50 tons per hour. Link-Belt Gearmotor and Roller Chain comprise the drive.

Bulk-Flo, a combined feeder-conveyor-elevator, reclaims coal at 10 TPH from live storage to surge hopper. Only the horizontal section of L-shaped path is shown.



Coal flows from Bulk-Flo to surge hopper, then through automatic weigh scale to a Link-Belt Screw Conveyor, which distributes to three stoker hoppers.

COAL HANDLING EQUIPMENT

LINK-BELT

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in Principal Cities. 12.007-A

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By ***Engineered Plant Services*** we mean the ***providing*** or ***generating, transmitting, controlling, applying,*** and ***maintaining*** of POWER, STEAM, MECHANICAL DRIVES, HEAT, ELECTRICITY, AIR, WATER, and other engineered services in and for all areas of the industrial establishment as required for production and operation. This includes Lubrication, Piping Systems, Industrial Waste Disposal, Corrosion Control, Electrical Systems, Industrial Heat, Coal and Bulk Handling, Dust and Fume Control, and other related services of an engineering nature.

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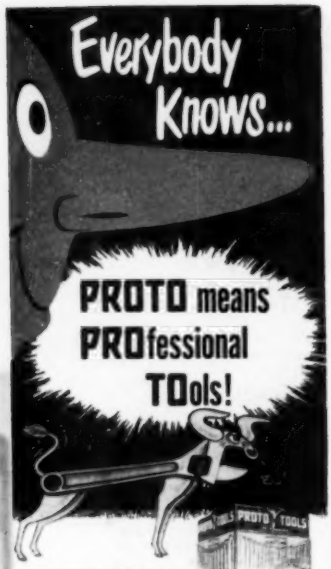

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Acorns of science

Developments not yet available, but of interest to those responsible for Engineered Plant Services

Vapor Plating

● For jet engines now, but the results of this process may someday be found in boilers and furnaces. Developed as a result of Air Force research, the method deposits coatings of pure high melting point metals, or borides, silicides, carbides or nitrides of the metals from a volatile compound of the metal. The part to be plated is heated in a furnace (with a volatile compound of the coating metal vaporized in the furnace atmosphere) to the temperature at which the compound is decomposed or reduced at the surface to form an adherent coating.

Usually, these refractory coatings cannot be produced by any other method. But because contamination can be avoided by vapor plating, coatings of high purity or unusual properties are obtained by the new method. Thicknesses up to $\frac{1}{8}$ in. are formed on a variety of bases.

Frozen Stresses

● Three dimensional photoelastic stress analysis is possible by a new method developed at Illinois Institute of Technology. A machined, plastic model of the part is placed in a special furnace and stressed. Loads are not removed until the part is cooled to room temperature, strains stay "frozen" in the model, which can be sliced or sectioned without disturbing the strain pattern. The sections can then be studied in the normal manner in a photoelastic polariscope. Studies of three dimensional stresses in complicated parts, hitherto impossible, have been made; may lead to better designs.

Better Plastic Plumbing

● New, high impact plastic, much tougher than general purpose styrene, and now employed in some refrigeration and military applications, will have uses ranging from plumbing fixtures to furniture, according to an ASME paper by Monsanto Chemical Co. engineers. Non-corrosive pipe, fittings and valves constitute a very large field of application.

Amyl Nitrates for Diesels

● Developed by Ethyl Corp. and being tested by the Navy is a new blend of amyl nitrates designed as a diesel fuel additive that will boost quality and ease refining requirements. Although now being produced only in test quantities, predictions are that the new blend will simplify the job of the refiners, increase the amount of usable fuel in a given quantity of crude and aid in fuel standardization.

Vacuum Tubes Get Smaller

● Make spacers of glass, quartz or plastic in a convenient size, then draw them down to microscopic dimensions and combine with metal or semiconductor electrodes to produce electron tubes about the diameter of an ordinary matchstick. This micromounting technique for electrodes in tiny electron tubes, subject of an Air Force Technical Report, should have no immediate effect on standard industrial tubes but small size is an advantage at extremely high frequencies and may aid development of plant communication and control systems.

Modern Tintypes

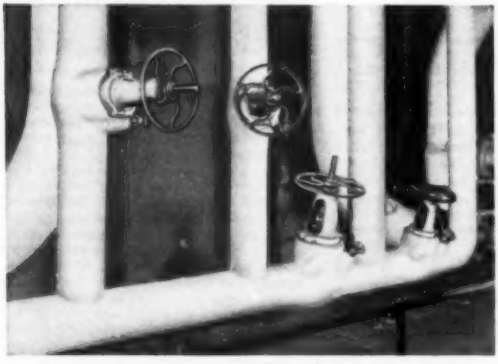
● A process used for printing photographically directly on an aluminum base is being studied at Horizons, Inc. Using conventional photographic negatives, the image is developed in surface layers of the aluminum sheet. Described as a recent Swiss invention, finished pictures are said to have extremely fine grain size and great durability, probably comparing with that of anodic aluminum finishes.

a better gate valve for 600-pound services ...CRANE pressure-seal bonnet design

Better—because these Crane valves completely eliminate bonnet joint maintenance. And because they assure power plants—industrial and utility—ideal flow conditions, with many added cost-reducing advantages.

For instance, they save on erection and suspension costs, because, size for size, Crane Pressure-Seal Bonnet Gates are much lighter in weight and more compact than flanged bonnet steel valves. Insulating Pressure-Seal valves takes less time and materials because of streamline contouring.

For complete information about Crane 600-Pound Pressure-Seal Bonnet Gates—also companion lines of 900 and 1500-Pound Gates, Globes, Angles, and Stop-Checks—send for Circular Ad-1819, or ask your Crane Representative for a copy.



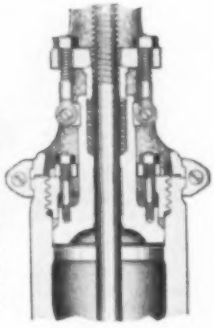
Boiler feedwater header in central station. No danger of bonnet-joint leakage; valves are Crane Pressure-Seal Bonnet Gates.

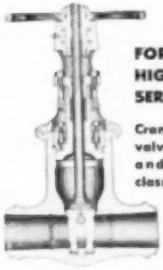
Patented and Patents Pending

600-Pound Butt Welding Gate for temperatures up to 1000° F. max.

NO BONNET-JOINT LEAKAGE OR MAINTENANCE

Bonnet joint is inside the valve, sealed with a wedge-shaped seal ring. Internal fluid pressure, acting upon the entire underside of bonnet, forces bonnet against seal ring and wedges it between the body and bonnet to form a pressure-tight metal-to-metal joint. Since pressure tightness does not depend on bolting, no periodic restressing of bonnet joint is needed.





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Crane Pressure-Seal Bonnet Gate valves are also available in 900 and 1500-Pound pressure classes.

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Highlights of new products by leading manufacturers

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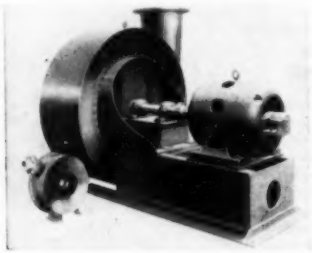
1—Blowers offer large capacity

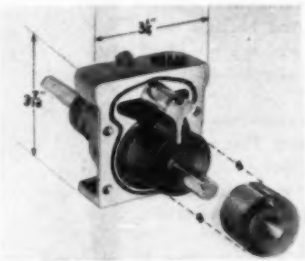
A line of fabricated steel blowers of large capacity, limited in size only by available manufacturing space, is announced by the Billmyre Blower Div. of Lamson Corp. Standard models in the line range up to 200 hp. In addition to larger size, the line offers weight saving and space economy not heretofore feasible in cast blower construction, without loss of durability, simplicity and efficiency. Three styles are offered: the model SG (multi-stage) and the SM (single-stage) operating at 3500 rpm; the model ST operating at 1750 rpm. Standard outlet pipe sizes run from 4 to 24 in., all flange fitted. The smaller models through 10 hp are particularly useful for elevated mounting in either vertical or horizontal positions. Designed on a standard basis for air only, they can be



adapted to the use of corrosive, poisonous or explosive gases on special orders. Blower outlets may be oriented in any of 14 positions depending on desired discharge angle and offset from shaft center line. Delivered air pressures up to 3 psi (5.3 mercury) may be had. Constant pressure is maintained irrespective of air volume, but power consumption is directly proportional to air volume. Principal uses to date include industrial vacuum cleaning systems, pneumatic material transport, carburetion for combustion, foundry and blast furnace work, liquid aeration and agitation, and gas or air circulation.

2—Pump handles all fluid chemicals

A line of Allchem chemical process pumps is announced by Eco Engineering Co. As standard equipment they have teflon impellers, a teflon packed stuffing box and a choice of teflon or graphitar self-lubricating bearings. Manufactured with stainless steel pump casings and shafts, these compact pumps are used for small volume process or laboratory work and find wide usage in transfer applications, to pilot plant and industrial applications. These positive displacement pumps are of particular interest to pharmaceutical, fine chemical and all other process plants. They provide an all-around pumping unit that will operate in either direction in capacities from 1 to 20 gpm and pressures up to 40 psi with excellent lift.



The pumps will convey virtually all fluid chemicals in the widest viscosity ranges. Once primed, the pumps are self-priming. Patented pumping motion prevents foaming, aeration and pipe line corrosion. Pumps are available in pump port sizes ⅜, ½ and ¾ in. pipe tap, with pulley drive base assembly, or base mounted direct connected with electric motors. Pump housing may be had in stainless steel or naval bronze.

TO REQUEST ADDITIONAL FREE DATA

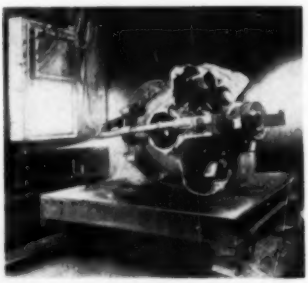
Each paragraph in this section is numbered —beginning with number 1. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out and mail this card. Our Reader Service Department will handle your request promptly

3—Flexible tubing has many uses

Spiratube, a flexible fabric tubing for ventilation and product handling, is being made by Flexible Tubing Corp. It is offered with vinyl plastic coating which gives good abrasion resistance for rough handling, and inertness to chemicals and oils. Light in weight, it is non-kinkable, and will not collapse under average fan suction pressures. The basic patented principle of construction consists of preformed, continuous, spring wire ribbing, which is overlapped with spirally wound woven fabric of several alternate types. After fabrication the tubing is coated with a Geon latex, providing the abrasion and chemical resistance. Designed initially as ventilation tubing, Spiratube is easily adapted to the conducting of air and other gases, many solids, and liquids at low pressures. Connecting or coupling sections of tubing together is done easily and tightly with an exclusive flexible belt clamp. Optimum flexibility makes elbows and other fittings unnecessary.

4—Castings blasted from moving car

Sandblasters at the Falk Corp. now do their work in an air-conditioned cab within a Pangborn Hydro-Blast room. The cab moves to any spot on three walls of the room and the operator directs an abrasive stream against the casting being cleaned. The ability of the abrasive stream to reach any casting surface, the elimination of heavy, cumber-



some work clothes, and the increased capacity of the mechanically held hose enable the operator to do more than three times as much work as he could previously. Main parts of the Hydro-Blast are the control car, a cleaning room, and the abrasives reclamation unit. The car, which also moves vertically, is mounted on a carrier which moves along three sides of the cleaning room on a monorail. The gun-nozzle has a capacity of 60 gpm at 2000 psi. Turret-like action of the gun allows rotation through 60 deg horizontally and 50 deg vertically. The cleaning room is 23½ ft long, 21 ft wide and 17 ft high. Castings are placed on a work car and pushed into the center of the room. Spent sand and water fall to the floor and drain off through a bargate to a reclamation unit.

5—Speed variation control offered

Reeves Pulley Co. has announced the availability of mechanical automatic control on its Series 1000 fractional hp Vari-Speed Motodrives. The Series 1000 Motodrives are made in ¼, 1/3, ½ and ¾ hp sizes, with speed variations as high as 10 to 1. These

(Continued on page 12)

JENKINS PRACTICAL PIPING LAYOUTS

57

How to plan

CONNECTIONS FOR COMMONLY USED TYPES OF METERS

In practically all industries meters are used to compute, accurately and automatically, the amount of flow. Fluids measured may be liquid, gas, or vapor (water, oil, gasoline, fuel gas, steam). Diagrams show the basic piping hookups for some of the more commonly used meters.

Orifice Type — generally used to indicate, totalize, and record moderate quantities of liquids, gases, or vapors.

Venturi Type — also indicates, totalizes and records. It is frequently used on condenser water supply units in power stations, water pumping stations, and sewage plants.

Area Flow Type — or Rotameter is for indicating, principally, in lines carrying fluids in moderate quantities.

Displacement Meter — usually totalizes only; this is the type used to measure water supply from city mains to buildings.

Valve recommendations include bronze, for ordinary service, and stainless steel where corrosive liquids are handled. Jenkins Fig. 106-A Bronze Globe is especially suited for shut-off service as recommended in these hookups. Jenkins All-Iron Valves are also available where desired.

Consultation with meter manufacturers is recommended to determine the type best suited for your particular service.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from the Jenkins Catalog. It's your best assurance of *lowest cost in the long run*. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.

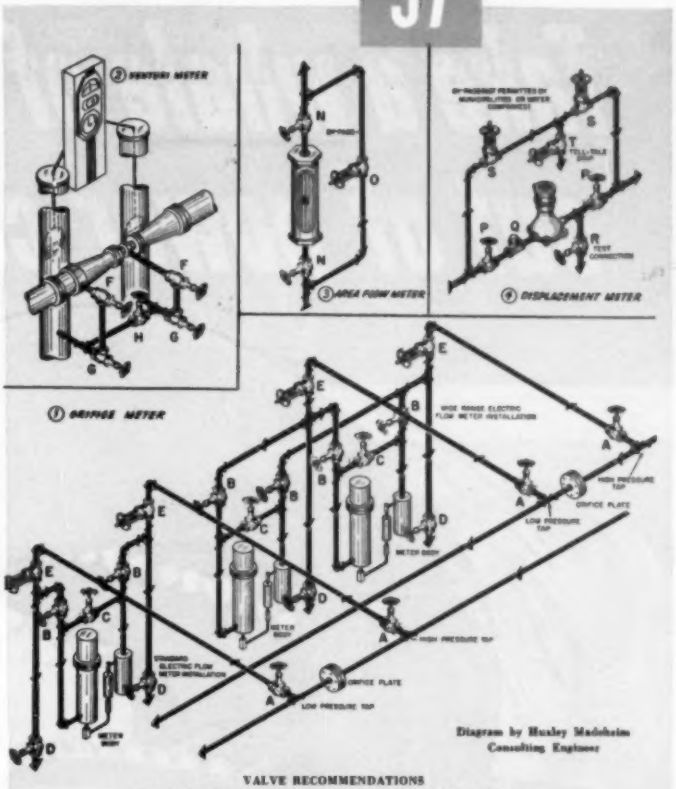


Diagram by Huxley Madeheim
Consulting Engineer

VALVE RECOMMENDATIONS
For details of valves to suit varying conditions see Jenkins Catalog.

	JENKINS VALVES					
	Code	Quan.	Bronze	Stainless		Service
ORIFICE METER	A	4	106-A	1308	Globe	Orifice Tap Shutoff
	B	6	106-A	1308	Globe	Meter Body Shutoff
	C	3	741-G	1308	Globe	Equalizing Line
	D	4	106-A	1308	Globe	Drain & Blow Down
	E	4	47-U	1302	Gate	Main Shutoff or Meter
VENTURI METER	F	2	108-A	1310	Angle	Piezometer Tap Shutoff
	G	2	108-A	1310	Angle	Tap Shutoff to Water Cock
	H	1	741-G	1308	Globe	Equalizer
AREA FLOW METER	N	2	106-A	1308	Globe	Meter Shutoff
	O	1	47-U	1302	Gate	By-Pass
DISPLACEMENT METER	P	2	47-U	1302	Gate	Meter Shutoff
	Q	1	92	1328	Check	Anti Back Flow
	R	1	106-A	1308	Globe	Test Connection
	S	2	47-U	1302	Gate	By-Pass
	T	1	47-U	1302	Gate	Tell Tale Drip

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TRADE MARK JENKINS MARK
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FEWER PULLEY GROOVES — LONGER BELT LIFE

There's a whale of a saving in power transmission costs when you use the premium Dayton Cog-Belt! It delivers 40% more h.p. than an ordinary V-Belt. Here's why—

Cog-Belts are built to bend—like your finger—to take up compression strains as the belt goes round the pulleys. Results: Less strain, less heat, less stretch, less maintenance, longer life, less down-time.

Save on the cost of original belting! You need fewer belts, fewer pulley grooves to do the job, when 5 Dayton Cog-Belts do the work of 7 ordinary V-Belts,—and do it better!

Save drive-space, plant space! Cogs permit much shorter center-to-center distances—up to 25% shorter. They save up to 47.2% in drive area.

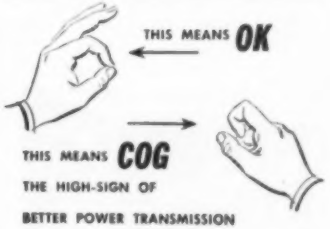
To end your V-Belt troubles for the long "duration" ahead, give your Dayton Distributor the "high-sign" of better V-Belt power transmission: the arched finger that means Dayton Cog-Belts and important savings!

*T.M.

DAYTON RUBBER COMPANY • DAYTON 1, OHIO

TAKE A TIP FROM A TIPPLE

14 years ago a set of Dayton Cog-Belts went to work, running the tipple at a coal mine at Logan, W. Va. These same veteran Cogs are still on the job! The mine superintendent predicts that they are good for years to come. If you have a drive that's a real toughie, turn it over to a team of Dayton Cog-Belts, for a long, trouble-free life!



Dayton Rubber

WORLD'S LARGEST MANUFACTURER OF V-BELTS

New equipment and developments

(Continued fom page 8)

Motodrives consist of the Reeves speed-varying mechanism and the user's choice of any standard motor, with a built-in helical gear speed reducer optional. Other Reeves units are the Variable Speed Transmission, in capacities up to 87 hp and speed variation as high as 16 to 1; and the Vari-Speed Motor Pulley, in capacities up to 10 hp and speed variations up to 4 to 1.

6—Starter combines disconnect switch

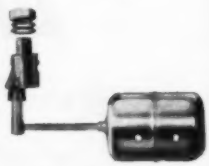
A combination across-the-line motor starter with fusible disconnect switch is available from Westinghouse Electric Corp. in NEMA sizes O through Z. This starter, designated as Class 11-204-N, consists of a disconnect switch, main line fuse clips, and a Life-Linestarter mounted in a common enclosure. The disconnect switch is of an improved design, with visible blades and De-Ion arc quenchers. A self-indicating slamproof handle is provided in the cover. Enclosures can be provided for general purpose NEMA type I, semi-dust-tight NEMA type IA, dust-tight NEMA type V, or NEMA type XII

to meet the JIC specifications of the mass-production industries. Starters are available for 3-phase operation, up to 600 v, 60 c.

8—Float valve has three variations

A float-operated valve has been announced by McDonnell & Miller, Inc. It provides large capacity with compact size, and combines husky, non-corrosive construction with simplicity of design and operation. Three variations of the valve are available. The No. 18 consists of the valve mechanism and float. The No. 118 is a variation designed to offer protection against back-siphonage, and has the float mounted at right angles to the valve so that the valve proper is always above the water level. The No. 518 includes the float and valve in a die-cast chamber with a cover, and is designed for external applications such as on humidifiers. Except for the neoprene valve seat, all valve parts are of copper or brass. The valve opens to full capacity with only small float drop, and closes tightly against supply pressures up to 100 psi. These valves can be used on humidifiers of warm air furnaces, evaporative coolers in air conditioning equipment, wet and dry bulb hygrometers, ice cube freezers, etc. Capacity of the valve ranges up to almost 1500 gph, depending on supply pressure. For mounting the valve, water supply connection has a ⅝ in. external machine thread with nut and washers. For water supply line this same connection has a ⅛ in. pipe tap.

No. 18



No. 118

TO REQUEST ADDITIONAL FREE DATA

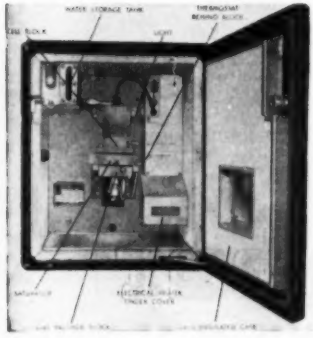
Each paragraph in this section is numbered —beginning with number 1. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out and mail this card. Our Reader Service Department will handle your request promptly

9—Thermometers indicate and control

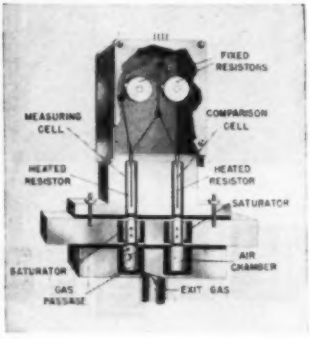
A line of resistance thermometers designed for accurate indication and control of temperatures ranging from minus 100 F to plus 300 F has been announced by the General Electric Co., Meter and Instrument Department. The instruments are available in three basic types: the HP-11 resistance-thermometer indicator; the HP-13 two-position controller or protector; and the HP-14 three-position controller. Each type is designed for either flush or surface mounting. All the thermometers use the same basic mechanism, a crossed-coil moving element and a high-strength, 3¼ lb alnico V magnet, designed

(Continued on page 16)

7—Recorder gives five second response



Availability of a CO_2 recorder featuring 5 sec response with accuracy of plus or minus 0.25 per cent is announced by Hays Corp. Constructed for industrial boiler plant use, the instrument utilizes three established ideas: 1) the use of CO_2 measurement as a guide to combustion efficiency; 2) the thermal conductivity principle of gas analysis; 3) electronic type operation. In operation, gas to be analyzed diffuses through a saturator into a measuring cell, where it conducts heat away from a heated resistor, thereby changing its electrical resistance. Simultaneously, saturated air likewise changes the resistance of a resistor in a comparison cell, this change being used as a constant reference. The two resistance changes are compared in the analyzer bridge circuit, which is connected into the recorder network. Here the measurement is amplified, indicated and recorded.



Photomicrograph of one type of silica scale in early formation stage. Further deposits will fill in between the "trees" to form a dense, glass-hard, insulating covering that is extremely difficult to remove—and impervious to usual water treatment techniques.

STONE FOREST

(The boiler scale that fought back)

● When silica scale was mentioned, water-treatment experts used to change the subject quickly . . . until a plant using The Nalco System began having scaling troubles due to high silica content of the raw water.

That was many years ago. Today, the same plant, operating at 135 psi, maintains 500 ppm (29.4 grains per gallon) silica in boiler water without scaling.

The Nalco research program that solved this low-pressure boiler water silica problem is a continuous one, so that today The Nalco System successfully meets the challenge of silica wherever it arises in the field of water conditioning.

Whether your water treatment problem is silica—or something even tougher—Nalco has the solution, or can put the full facilities of the Nalco Laboratories to work on it for you.

LATEST STUDY ON SILICA CARRY-OVER

At operating pressures over 400 psi another silica problem—that of silica carry-over—often arises. One of the 1951 ASME papers, "Correlation of Silica Carry-over and Solubility Studies" is an up-to-the-minute, informative discussion of this problem. You are welcome to a copy. Just write to National Aluminate Corporation.

NATIONAL ALUMINATE CORPORATION

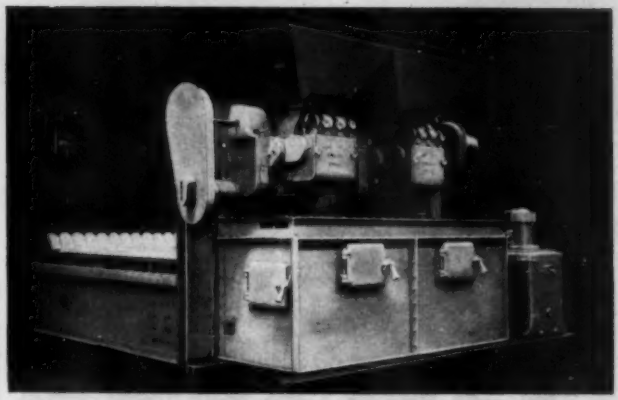
6218 W. 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM . . . Serving Industry through Practical Applied Science

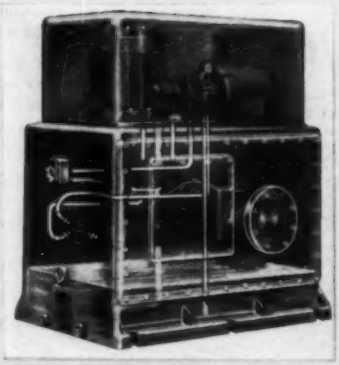
"TRAVA

MOST MODERN DEVELOPMENT



by ERIE CITY

The Erie City TRAVAGRATE Spreader Stoker, for continuous ash discharge operation, is the latest addition to the Erie City Stoker line. It incorporates simplicity, easy regulation and rugged construction. Among the many TRAVAGRATE features are: Selective feeder speed for wide ranges of fuel size and consist; flexible fuel control to assure proper distribution to all parts of the moving grate; a range of grate speed satisfactory for all loads and infinite speed selection between zero and maximum rate of travel. For the complete Erie City Spreader Stoker story write for catalog SB42-B.



A Compact Hydraulic Unit drives the TRAVAGRATE

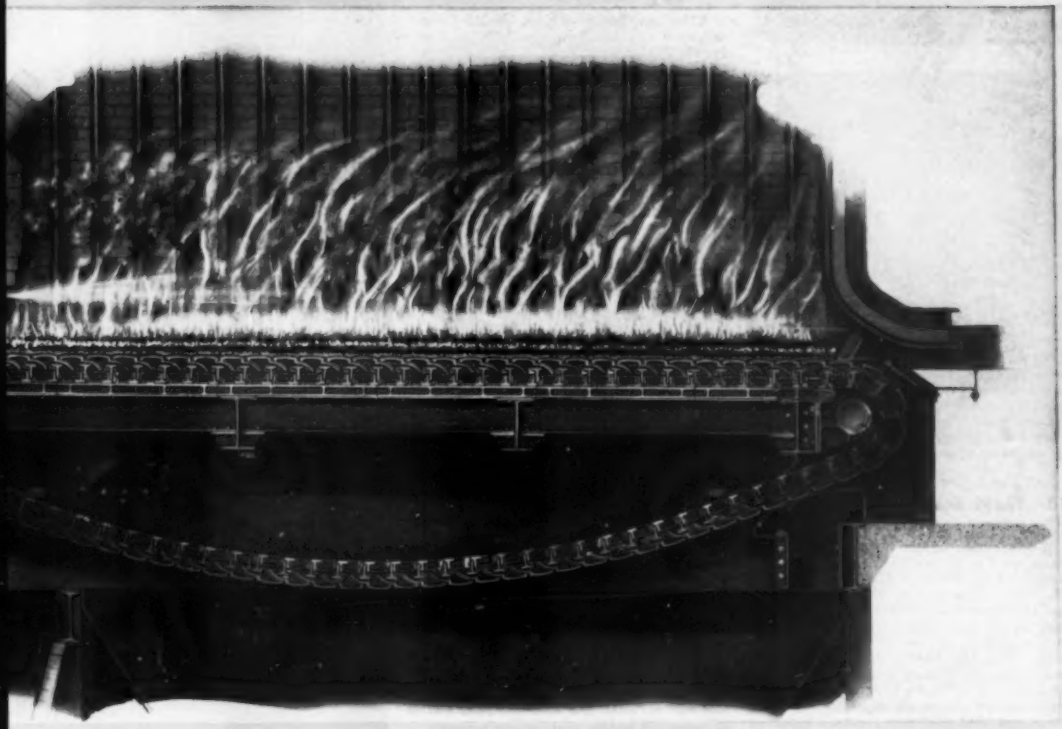
The self-contained hydraulic drive unit is contained in a single housing without external piping. The fluid drive transmits power to the main drive shaft through a linkage and ratchet gear. A single control valve regulates speed. The drive requires no shear pins since the relief valve opens to protect the equipment should the need arise.

ERIE CITY IRON WORKS

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED and SPREADER STOKERS • PULVERIZERS

GRATE"

IN SPREADER STOKERS



Ruggedness is Built into the TRAVAGRATE

Removal of grate sections shows the husky drive shaft and heavy duty sleeve type bearings. All bearing lubrication is provided from a central location outside the stoker structure. TRAVAGRATE grate sections do not separate as they turn around the sprockets. Each grate section fits snugly but in such a manner that replacement can be made quickly.

Erie, Pa.

New equipment and developments

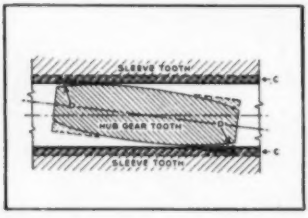
(Continued from page 12)

for hard usage and reliable operation. The entire mechanism is enclosed in a dust-tight, moisture resistant case and cover assembly that permits its use in moist or contaminated atmospheres. Typical examples of equip-

ment with which the thermometers are used include enamel baking ovens, vacuum dryers, low-temperature extruding machines, quenching tanks, distillation kettles, rubber vulcanization apparatus, and aging ovens. They also find use in the food processing, air conditioning and refrigeration industries.

10—Tooth design aids power transmission

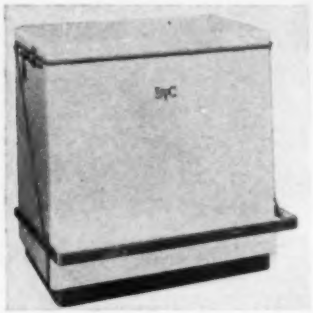
A gear tooth design for gear-type couplings used in the transmission of power is announced by American Flexible Coupling Co. This design permits all the load to be carried on the strong flanks of the tooth rather than on the tooth edges, reduces backlash to a minimum, and provides greater flexibility. Principle of the tooth design is centered around the fully crowned shaping of the hub teeth of the coupling. They are so contoured on all contacting surfaces of the crown and flank that they present a tighter fit of exceptionally close tolerance with the



internal spline teeth of the floating sleeves. To compensate for misalignment between connected shafts within the gearing, the length of the hub teeth was increased by an amount equal to the normal clearance for standard teeth, and the tips were crowned with a radius equal to the outside radius of the gear. The design allows the tip of each tooth to contact the root of the internal spline tooth in the sleeve of the coupling, piloting it with a ball and socket action. Chamfering the tooth edges avoids interference with the spline tooth fillet and transfers the contact to the head flank of the gear tooth. Thus the flank, or strongest part of the tooth, carries all the load while providing for the correction of lateral and angular misalignments. The tooth design is incorporated in Amerigear type couplings, and has been adapted to many different applications for power transmission.

11—Cabinet cools to minus 40 F

A low-temperature cabinet, designed for industrial use, has been introduced by the Brewer-Titchener Corp. The cabinet known as the Rigid-Frigid, features sub-zero



temperatures as low as minus 40 F. It can be used for rivet cooling, shrink fit assembly, size-stabilization in metal, storing punched and formed aluminum alloy parts, applying sub-zero cooled compressed air to metal cutting tools and treating hardened steels. It is a compact unit 40 in. long x 36 in. high x 32 in. wide. It has 2½ cu ft of refrigerated storage space. A feature of the cabinet is its easy-acting foot treadle which opens the lid and leaves both hands free for handling parts and materials. The cabinet is powered by a 1/3 hp hermetic unit, operating on 110 v a-c.

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12—Loader controls oil pressure

Askania Regulator Co. has developed a panel-mounted oil pressure loader for manually controlling oil pressure to devices normally operated automatically. Both automatically controlled and manually controlled pressures are indicated on gages, so that the operator can avoid discontinuity by matching the two pressures before switching from one mode of control to the other. A three-way valve selects the mode of control. The device is especially useful in starting up hydraulically-controlled equipment. Standard output pressure range is 0-60 psig with an oil supply pressure of 100 psig. Variations

in supply pressure do not affect output pressure unless supply pressure falls to within about 5 psig of output pressure.

13—Alloy fittings extra thick

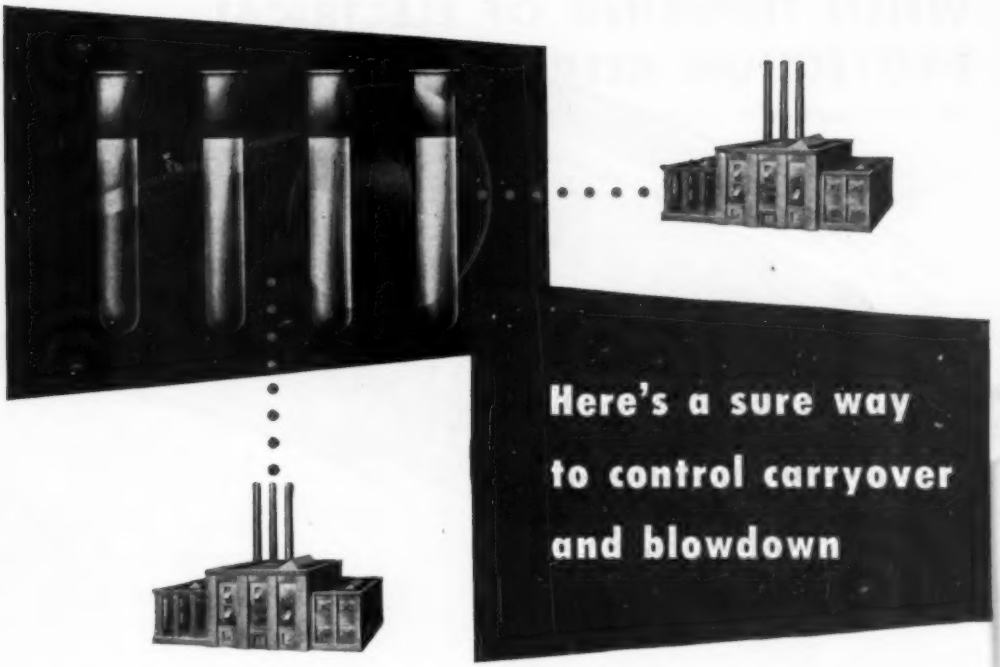
Key Co. has announced the development and production of a complete line of Key-Kast alloy steel welding pipe fittings and flanges. Based on a design of greater wall thickness throughout and added thickness at areas of stress, the line provides a stronger fitting and gives longer life to piping systems. The line meets ASA, ASME and ASTM standards, and is available in low

and intermediate alloys and various types of stainless steel, in all sizes and schedule numbers. A boss is provided on all fittings for tapped openings.

14—Oven has eight sliding drawers

Grieve-Hendry Co. offers their Model TD portable electric oven with eight drawers that permit baking of different materials at the same time, or materials inserted at intervals. High temperature magnesium strip heaters provide efficient heating. Light weight of only 118 lbs makes it easy to move. Temperature control is by thermostat and is adjustable up to 325 F. Oven plugs into 110 v outlet. Adjustable damper controls volume of forced air circulation, with stale air being forced out through specially located exhaust ports. These ovens can be

(Continued on page 20)



Here's a sure way to control carryover and blowdown

Impure steam and excessive blowdown are two "bugaboos" that need not be tolerated by any power plant engineer, thanks to effective anti-foam agents.

Within recent years, the Betz organization has developed several anti-foam agents which have produced remarkable results both from a standpoint of better boiler operation as well as direct savings.

For instance, a large midwestern plant operated at 250 pounds pressure and used boiler feedwater softened by the hot lime soda process. The river water used as make-up at this plant varied widely in composition and was contaminated by a number of industrial wastes. Highly impure steam was produced with boiler water concentrations of approximately 3,000 ppm.

After analysis, Betz Engineers applied properly formulated anti-foam agents to this problem. Boiler water concentrations were raised to the extremely high value of 16,000 ppm before a similar steam impurity developed!

The positive control of carryover and boiler blowdown is only one of the many services extended by the Betz Organization. Let us explain to you how our *complete* engineering guidance can help you solve all your water problems. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

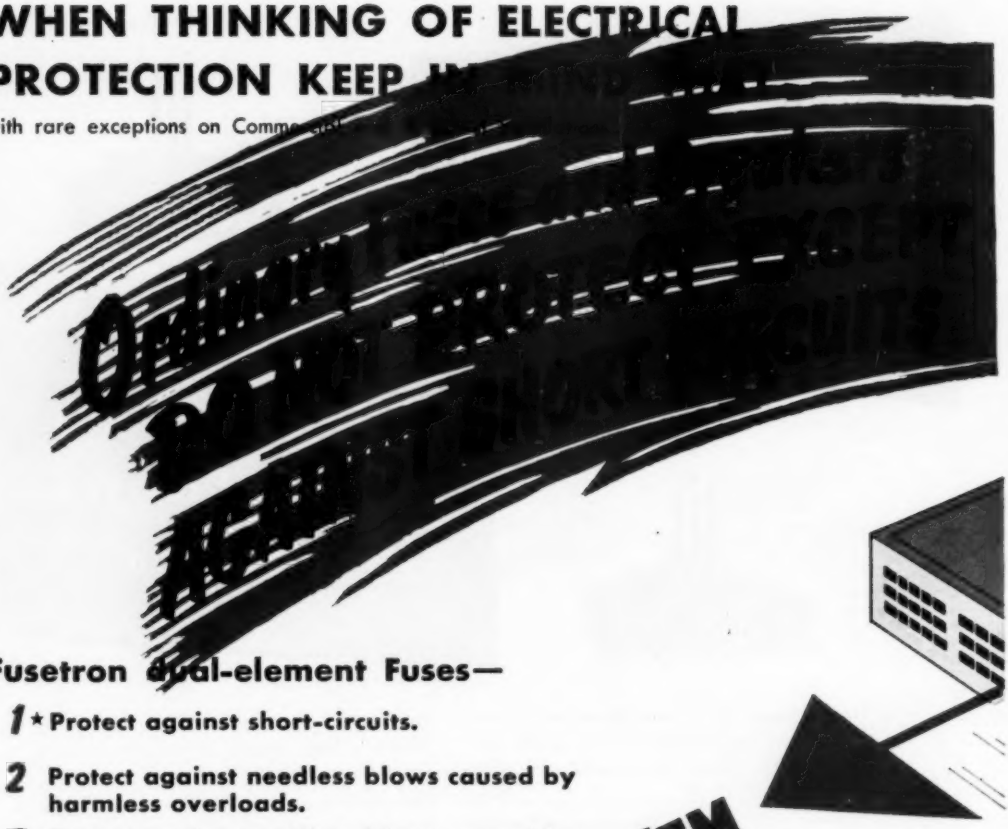
For the complete story on carryover and blowdown control through the use of anti-foam agents, write for Technical Paper No. 115.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

WHEN THINKING OF ELECTRICAL PROTECTION KEEP IN

with rare exceptions on Comme



Fusetron dual-element Fuses—

1. ★ **Protect against short-circuits.**
2. **Protect against needless blows caused by harmless overloads.**
3. **Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.**
4. **Provide thermal protection — for panels and switches against damage from heating due to poor contact.**
5. **Protect motors against burnout from overloading.**
6. **Protect motors against burnout due to single phasing.**
7. **Give DOUBLE burnout protection to large motors — without extra cost.**
8. **Make protection of small motors simple and inexpensive.**
9. **Protect against waste of space and money — permit use of proper size switches and panels.**
10. **Protect coils, transformers and solenoids against burnout.**

COUNT 'EM

DON'T RISK LOSSES

One **needless** shutdown . . .
One **lost** motor . . .
One **destroyed** switch or panel
One **burned out** solenoid . . .

May cost you far more than replacing every ordinary fuse with a Fusetron dual-element Fuse.

Mail the coupon now for complete information about the All-Purpose Protection of FUSETRON Dual-Element FUSES.

(FUSETRON is a trade mark of Bussmann Mfg. Co., Division McGraw Electric Co.)

* Fusetron Fuses have high interrupting capacity shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

*Name*_____

*Title*_____

*Company*_____

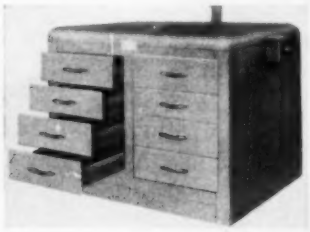
*Address*_____

*City & Zone*_____ *State*_____ 152

New equipment and developments

(Continued from page 16)

used in a group or battery, or stacked one on top of the other. Optional equipment is outside reading thermometer, timer, pilot light, and exhaust chamber adapter. Outside dimensions are 30 in. wide x 25 in. deep x



24 in. high. Inside dimensions are 28½ in. wide x 24 in. deep x 20⅛ in. high. Drawers 2 in. high x 11½ in. wide x 23 in. deep.

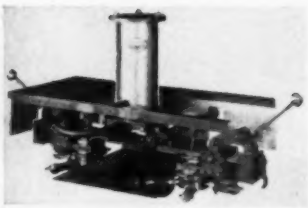
15—Cutting torch uses gasoline

A cutting torch to be made by Browning Torch Corp. burns gasoline and oxygen and is claimed effective on such operations as cutting, brazing, scarfing and similar work. Advantages claimed are reduction in bulk and weight by elimination of large acetylene cylinders in favor of small gasoline cans,

and a cutting head design which eliminates backfiring and backflashing into the torch handle. Basically, the torch blends liquid gasoline and oxygen, which is converted into vapor in the torch tip by the heat of the flame.

16—Device automatically lubricates trolleys

An automatic conveyer lubricator with enclosure especially designed for foundries or other operations where an unusual amount of contamination circulates, is announced by the J. N. Fauver Co., Inc. This is a self-contained grease lubricator type, driven by contact with the trolley wheels. As the trolley wheel approaches lubricator, hub engages sleeve of one of the five pumping units. Continued rotation of the lubricator forces



the pumping unit inward, delivering a measured quantity of lubricant to the wheel bearing. Then a cam located in the pump housing snaps the next pumping unit into position to contact the next wheel. Operates on conveyer wheels equipped with or without Zerk hydraulic fittings.

17—Ceramic coating resists high heat

High-temperature ceramic coatings that enable low-carbon steels to last as long and perform as efficiently as high-alloy metals are now available to industry through Ferro Corp. Tests prove that coated low-carbon steels have life and performance characteristics equal to uncoated high-alloy steels. Coated high-alloy steels provide greatly expanded life and performance characteristics. Originally developed to protect jet engine parts, the coatings are expected to find applications in many industries. To date, tests indicate that the coatings can be successfully applied to equipment for petroleum fractionating processes, to bearing surfaces on motors working under high temperature conditions, in industrial furnaces, and in home heating equipment.

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18—Tester features observation scope

An industrial electronic surge comparison tester used to locate insulation faults and winding dissymmetries in motors, a-c and d-c generators, transformers and coils,

is available from Westinghouse Electric Corp. Available in either mobile or portable models, the tester simultaneously tests turn-to-turn, phase-to-phase, and coil-to-ground insulation. With every test setup, high-frequency and high-potential qualitative tests of resistance, impedance and turn balance are made, and the results obtained by a single scope observation. Non-destructive testing is assured even on fractional hp motors and generators, and destructive fault location is possible in many cases.

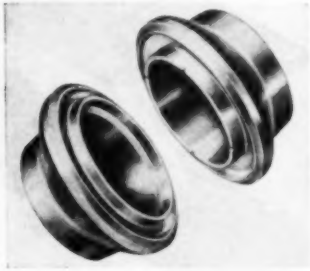
19—Pumps self priming in presence of vapor

Ingersoll-Rand Co. has introduced a line of self-priming pumps intended for pumping under suction lift where presence of air or vapor makes it impractical to use conventional pumps. Applications include mine drainage, bilge pumping and sump draining. The pump impeller discharges through two passages into a discharge chamber. During priming the upper pas-

sage discharges a mixture of vapor and liquid into the discharge chamber, where the vapor separates and passes out the discharge pipe. The remaining liquid then reenters the impeller through the lower passage to mix with more vapor drawn in. When the pump is primed, flow through the lower passage reverses and both passages act as normal pump discharges. Sizes range from ¼ to 25 hp, with capacities up to 800 gpm and heads up to 180 ft. Standard models utilize cast iron casings with bronze impeller.

20—Welding coupling prevents scale

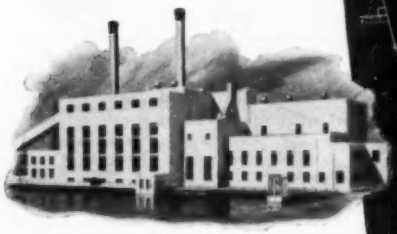
Tube Turns, Inc., announces the Tube-Turn SF (scale-free) welding coupling, designed to eliminate damaging welding scale

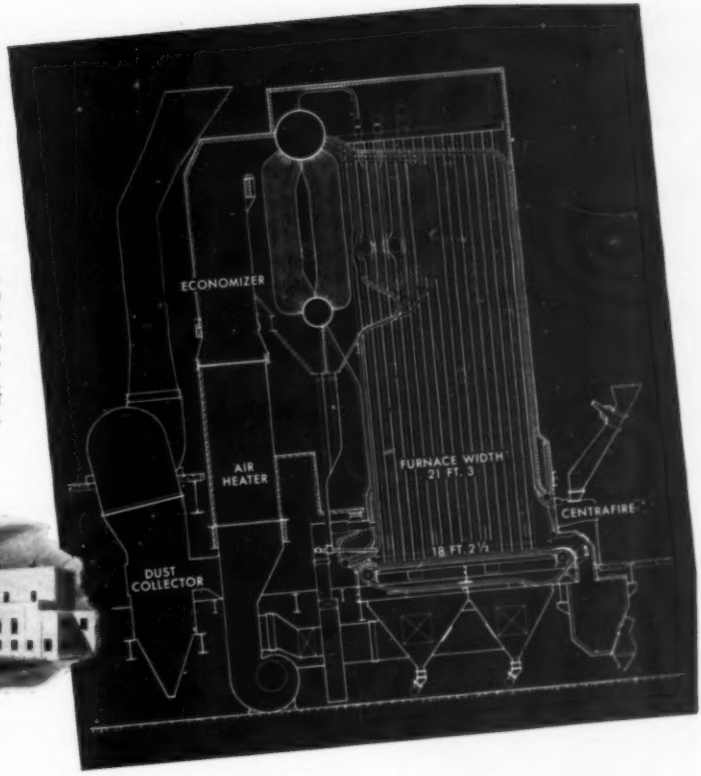


from piping systems. The coupling consists of two forged halves. Ends of the hubs are prepared for welding to pipe or welding fittings of the same size. When the two

(Continued on page 22)

Engineers for the Bay Front Steam Plant of the **Lake Superior District Power Company** at Ashland, Wisconsin, were **Sargent & Lundy**. The Westinghouse Centrafire with Traveling Grate will carry a constant load of 200,000 lbs. of steam per hour, with peaks of 230,000 lbs. of steam per hour.





CONSTANT LOAD 200,000 lbs. per HOUR... another Centrafire triumph!

The Westinghouse Centrafire® with Traveling Grate now being installed for the Lake Superior District Power Company is one of the largest Centrafire units that has been ordered to date. This utility and their consulting engineers wanted a stoker that could maintain a constant load of 200,000 lbs. of steam per hour . . . with peaks of 230,000 lbs. of steam per hour . . . despite continuous feeding of wet and storage coal. Moreover, they needed a stoker that could absorb foreign objects in the coal, without interruption or damage to the apparatus.

The ability of the Centrafire to "take it" and continue without load loss under severe conditions has been demonstrated in factory tests and in power plant installations. Wet coal, storage coal, bricks, blocks of wood, insulators, cable, bolts and many other foreign objects have been deliberately introduced into the feeders with no adverse effect.

There are many other features that make the Centrafire outstanding . . . they're built into the basic design, not added as accessories. Whether your application calls for 50,000 lbs. of steam per hour . . . or 350,000 . . . the Centrafire with Traveling Grate offers advantages you should investigate. Call your nearby Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-50537

YOU CAN BE SURE... IF IT'S Westinghouse

STOKERS

New equipment and developments

(Continued from page 20)

halves of the coupling are brought together, the tongue of one slips into the groove of the other. A circumferential cavity directly beneath the beveled welding area prevents burn-through or the formation of icicles in the interior from the extreme welding heat and prevents scaling. It is available in sizes from 1¼ in. through 12 in. and in carbon steel, stainless steel, aluminum and other metals and alloys.

21—Electronic timer extremely accurate

The Model 701 electronic timer offered by Timetrol Co. provides accuracies within ½ per cent of time cycle. Time interval is continuously adjustable, and accuracy is unaffected by supply voltage fluctuations. Timing cycle is initiated by a contact closure

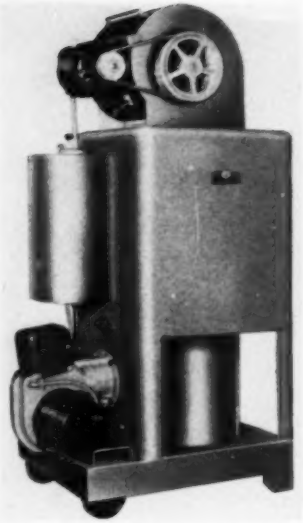
and a spdt relay is operated at the end of the timed interval. Intervals from 0.05 to 20 sec can be furnished. The relay contacts are rated at 115 v, 5 amp, non-inductive. The timer operates on 105-130 v, 50-60 c. Recycling is instantaneous. Unit is 6 in. long, 3 in. wide, 6 in. high, and can be panel or surface mounted.

22—Floor patch bears traffic immediately

Broken concrete floors can be restored quickly with Instant-Use, manufactured by Flexrock Co. It is claimed that a patch takes traffic almost at once. Material is shoveled into hole or rut, tamped, and traffic can pass over repaired spot immediately. It is especially recommended for repairing breaks in concrete due to relocating machines, but is also efficient for complete overlays.

23—Heat machine throws warm air blanket

A 140,000 Btu heat machine for indoor or outdoor use is announced by Fageol Heat Machine Co. Known as Model PW-140, the machine blows warm air out of the base in all directions along the floor,



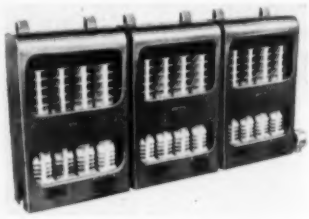
creating a 6-ft-high heat blanket. It is designed to comfortably heat workers in areas up to 3000 sq ft of confined space or 1600 sq ft of open space. A 200,000 Btu model known as PW-200 is also available. Both burn regular furnace type fuel oil or kerosene.

TO REQUEST ADDITIONAL FREE DATA

Each paragraph in this section is numbered —beginning with number 1. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out and mail this card. Our Reader Service Department will handle your request promptly

24—Convection heater is explosion-proof

A 6000 w convection type explosion-proof heater has been developed by the Electromode Corp. Especially designed for use in atmospheres containing gasoline, petroleum, naptha, acetone, benzol, lacquer, solvent vapors and natural gas, it is approved by Underwriters' Laboratories for use in Class 1 Group D hazardous locations. Featured is the exclusive Safety-Grid heating element which consists of a nickel chromium resistor wire, insulated and sheathed in a seamless metal tubing which is imbedded in a one-piece finned aluminum



casting. This completely seals the element, eliminating fire, shock and burn hazards. The aluminum grid remains at a low operating temperature, but has high thermal conductivity and is 100 per cent efficient. The heaters are made in three models with ratings of 2000, 4000 and 6000 w, designated as Models CX-2, CX-4 and CX-6.

25—Regulator is hermetically sealed

An addition has been made to the line of self-operated temperature regulators made by Farris Stacon Corp. Known as type UBA, the regulator is packingless, single seated, fully balanced, and hermetically sealed for reliable operation under the most adverse conditions.

Handy visual control is provided by a dial adjustment on top of the regulator. It is available in ¼, ⅜ and ½ in. sizes for steam pressures to 150 psig, and control of temperature between 30 F and 325 F. Control can be applied over a 60 F range. Eight ft of capillary tubing and 1 in. NPT connection on the bulb are standard equipment.

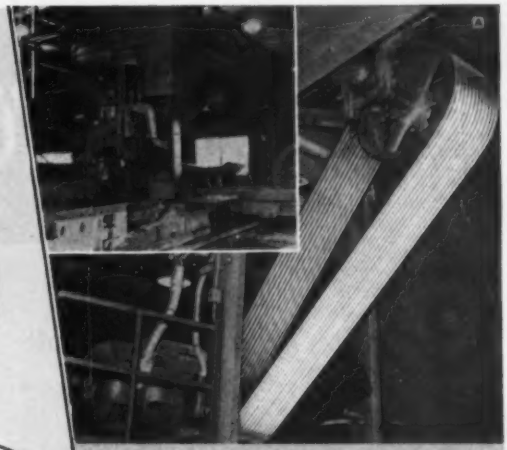
26—Diffuser controls air flow

Universal Diffuser Corp. announces the development of their Flexiflo series of adjustable air diffusers. The Flexiflo diffuser with its variable effective area permits adjustment of the air flow for any setting from zero to full volume or changes in the air throw, without changing the characteristic air diffusion pattern. The diffuser proper consists of a double-flanged conical spiral in which the continuous blades are flexibly held in position by means of radial spokes and connected to the main cross bar by means of a threaded center rod. By turning the center rod knob, the continuous diffuser

blades may be shifted to any position from closed to wide open, thus providing variable adjustment of the effective area with resulting volume and throw changes, while the air diffusion pattern remains constant. The unit has an equalizing deflector as an integral part of the equipment. The deflector vanes are individually movable and will re-

(Continued on page 27)

Prove for yourself why Gates Vulco Ropes are giving you longer V-Belt Wear!



This big bandmill, in the Masonite Corp. plant at Ukiah, Calif., is driven by Gates Vulco Ropes. The saw has a capacity of 200 thousand board feet of lumber in 8 hours.

There is a very simple reason why Gates Vulco Ropes—the V-belts built with *concave sides*—are giving you substantially *longer wear*—and you can easily prove this for yourself in just 2 minutes' time!

Pick up *any* V-belt whatever and bend it as it bends when going around a pulley. As the V-belt bends, grip its sides with your fingers—and here is what will happen, every time.

If the belt you are bending is a *straight-sided* V-belt, you can *feel* its sides *bulge out* as the belt bends. This out-bulge forces the sides of the belt to press *unevenly* against the V-pulley—as shown in figure 1-A (see accompanying diagrams).

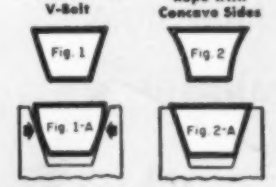
Clearly, this *uneven pressure* against the V-pulley causes the belt to wear *unevenly*—with the wear *concentrated* where the bulge is greatest—and this concentrated wear at one point naturally shortens the life of a *straight-sided* V-belt.

Now, make this same test with the belt that is built with Concave Sides—the Gates Vulco Rope!

Whereas you felt an *out-bulge* when you bent a belt with straight sides, you find that the *Concave Sides* merely fill out and become *perfectly straight*. The sides therefore *press evenly* against the V-Pulley. This distributes the wear *uniformly* across the *full width* of the belt. Naturally, this means longer belt life and *lower* belt costs for you!

Only V-Belts made by Gates are built with concave sides. Whenever you buy V-Belts, be sure that you get the V-Belt with the Concave Sides—The Gates Vulco Rope!

What Happens When a V-Belt Bends



How Straight-Sided V-Belt Bulges in Sheave -Groove. Sides Press Unevenly Against V-Pulley Causing Extra Wear At Point Shown by Arrows.

The Concave Sides Fill out to a Precise Fit in the Sheave Groove. No Side Bulge! Sides Press Evenly Against the V-Pulley—Uniform Wear—Longer Life!

CS-5110

Gates® Hose · V-Belts · Molded Rubber Goods for Industry

VULCO ROPE DRIVES

ENGINEERING OFFICES AND JOBBER STOCKS IN ALL INDUSTRIAL CENTERS

THE GATES RUBBER COMPANY • DENVER • U•S•A

World's Largest Maker of V-Belts

CHEMICAL PROCESS INDUSTRIES:

Here's Your Guide to

For The Electrolytic Production of:

- CHLORINE
- HYDROGEN
- OXYGEN
- SODIUM M
- FLUORINE
- COPPER
- ZINC
- ALUMINUM
- MAGNESIUM
- MANGANE

SEND FOR YOUR COPY OF BULLETIN 5106 TODAY!

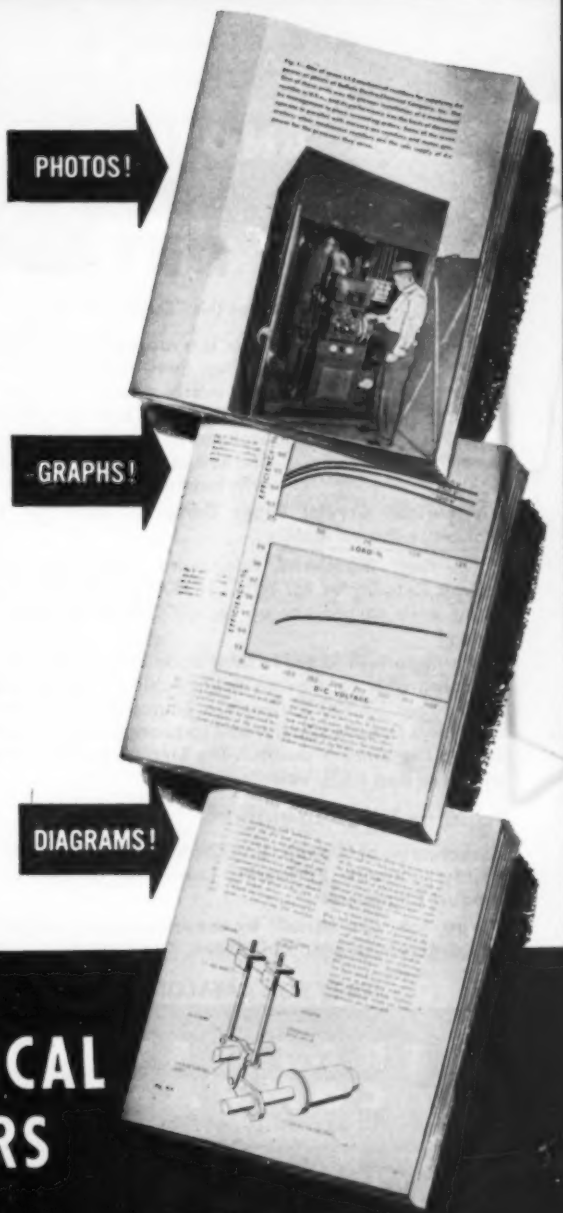
More Efficient Power Conversion

How you can get *95 to 97 per cent rectifying efficiency* for electrolytic production of chemicals at 3000 amperes and up is told in I-T-E Bulletin 5106.

Here is the story of the I-T-E Mechanical Rectifier—how it offers you direct current at lower cost; how its efficiency and economies in installation, operation and maintenance will save you money all along the line. Now you can plan your cell layout the way you want it—and get all the advantages of using low d-c voltages—greater safety to personnel —lower leakage losses to ground.

This comprehensive 32-page bulletin is packed with informative charts, diagrams and illustrations explaining the Mechanical Rectifier's operation.

Bulletin 5106 is yours for the asking. Send for it today. I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pa.



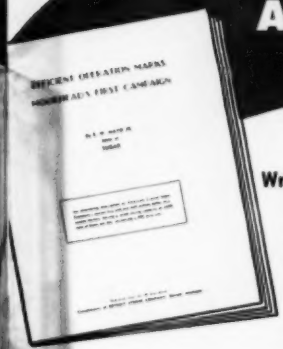
I-T-E

MECHANICAL RECTIFIERS

AMERICAN CRYSTAL SUGAR COMPANY

ANOTHER FOOD PLANT

DETROIT STOKERS



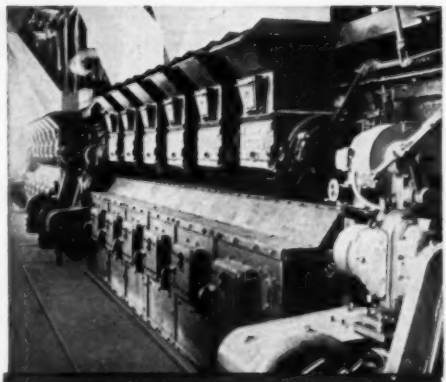
Write for this "Sugar" article

Heat is a major item in food processing. Fuel, therefore, is one of the main expenses. Coal, the "Basic Fuel," burned with Detroit Stokers is the Most Economical Method of Producing Heat. That's why leading Food Plants use them.

American Crystal Sugar Company uses ten Detroit Stokers in three Plants.

For their Moorhead, Minnesota Plant, they selected Detroit RotoGrates for two 110,000 pound steam generating units to process up to 3,000 tons of sugar beets a day.

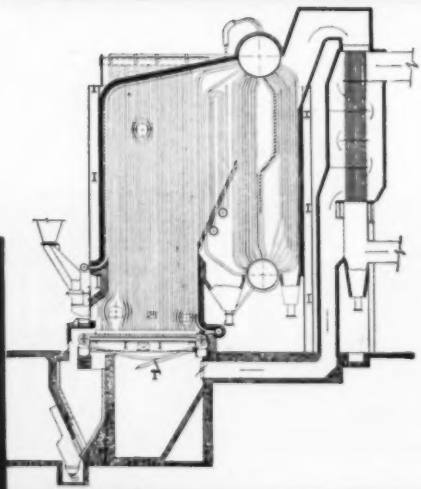
An important factor in their decision was the necessity of being able to provide dependable steaming capacity with either 13,500 Btu Eastern Bituminous Coal or 6,800 Btu North Dakota Lignite, and to change readily from one fuel to the other if desired. The Lignite, burned has 29% moisture and 38% volatile.



Popular With Engineers

Cleanliness of Detroit RotoGrate firing combined with ability to handle fluctuating loads also appeals to Food Product Engineers.

You, too, can benefit by these operating advantages. Investigate now—no obligation.



WRITE FOR CATALOG TODAY

DETROIT STOKER COMPANY

OTHER TYPES AND SIZES OF DETROIT STOKERS FOR EVERY INDUSTRIAL OR POWER NEED

New equipment and developments

(Continued from page 22)

main fixed in any position. The diffuser is available in eleven sizes, the largest being capable of handling up to 9000 cfm with a throw of over 48 ft.

27—Ohmeter designed for convenience

The Megger low resistance ohmmeter offered by James G. Biddle Co. is designed for maximum convenience in field use. The set is completely self contained, with a

compartment for storing leads and hand spikes. It is supplied in two models, both having the ranges of 0 to 1000 and 0 to 10,000 microhms. Model 1B is a battery powered set, and Model 1R has a built-in rectifier which can be plugged into any ordinary lighting circuit outlet. The complete units, with batteries or rectifier, weigh about 19 lbs. The ranges of the instrument cover a wide variety of applications, and its compactness makes it particularly applicable to power system and railroad use.

HOW TO REQUEST FREE BULLETINS

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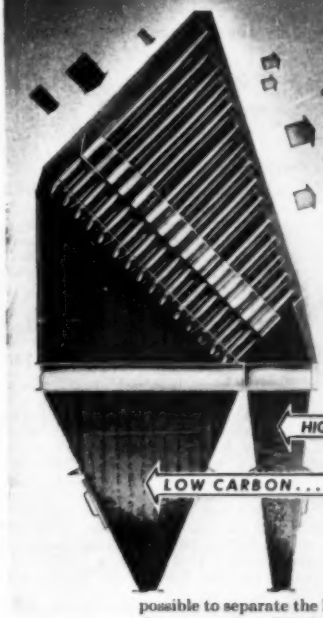
28—Breaker provides time delay

The Magnette panelboard circuit breaker is announced by the Heinemann Electric Co., designed to be interchangeable with many other conventional breakers. Employing a fully magnetic operating principle, its rating is not affected by room or internal panelboard temperature. On simple

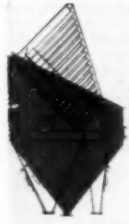
(Continued on page 144)

REFIRE HIGH CARBON DUST
without recirculating fly-ash



. . . install P-D
TUBULAR DUST COLLECTORS
arranged for DECANTATION

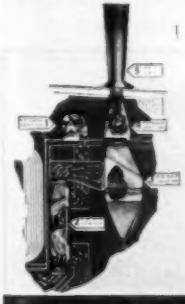
In a single phase P-D tubular collector, designed for decantation and *requiring no additional pressure drop*, it is now possible to separate the large particles of high carbon content from the non-combustible finer particles.



Fly-ash from spreader stoker-fired units, consisting of up to 40% high carbon particles, can effect considerable savings when re-injected. It is necessary to effect separation, however, since the non-combustible smaller particles remaining in the system increase in concentration, causing erosion and possible poor combustion due to spotting.

Space requirements for the decantation design are not as great in area and only slightly higher than a standard tubular . . . and, collection efficiency is high. Superimposed sketch shows comparative size.

Why waste fuel? Investigate this collector today, it will soon pay for itself. Write our Sales and Project Engineers for Bulletin 260 D.



UNIT RESPONSIBILITY

Prat-Daniel, through its sales and project engineers, The Thermix Corp., offer a complete complement for handling the air gas stream: Forced Draft Fans, Air Pre-heaters, Tubular Dust Collectors, Induced Draft Fans and Fan Stacks. This unit responsibility, by a well known firm, relieves the engineer of the responsibility for one of the most important functions in a steam generating plant.

Sales and Project Engineers
THE THERMIX CORPORATION
GREENWICH, CONN.

Canadian Affiliates: T. C. CHOWN, LTD.
1440 St. Catherine St. W., Montreal 25, Quebec
50 Abell St., Toronto 3, Ontario

Designers and Manufacturers
PRAT-DANIEL CORPORATION
SOUTH NORWALK, CONN.

New bulletins and catalogs

Literature on engineering products and developments

Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Insert key numbers on return post card found on page 131

AIR & DUST FILTERS & COLLECTORS

Gas Scrubber **200**

Six page bulletin 203-B features a gas scrubber to clean, cool or absorb gases. Applications, advantages and operating principles are discussed and illustrated with typical installation photos, cross-section diagrams, and capacity curve sheet. Peabody Engineering Corp.

Dust Collector **201**

"Don't Let Dust Be Your Destiny", a 16-page booklet, should be of interest to engineers concerned with dust collection. Collector using wool felt as the filter medium is fully described, including principles of operation and engineering data. Numerous case histories are described and fully illustrated. Pulverizing Machinery Co.

ANTI-CORROSIVE & PROTECTIVE COATINGS

Asphalt Coating **202**

Brochure, 4 pages, gives detailed application data and lists uses of weatherproof, mineral-armored asphalt. Includes specifications, application data, approximate costs, and illustrated, detailed information regarding equipment used in applying. American Bitumuls & Asphalt Co.

Paint-anchoring Treatment **203**

Paint-anchoring corrosion-resistant phosphate treatment for metals is described in 8-page booklet. Details the common causes of paint failure and how they can be prevented, then goes into methods of application—immersion and spraying—of the treatment. Typical uses are listed. Octagon Process, Inc.

BATTERIES & CHARGERS

Storage Battery **205**

Self-discharge in storage batteries has been reduced 80% by using lead-calcium grids, according to 4-page bulletin 6B-1442-1.5. Research and all pertinent data are thoroughly discussed, and several graphs are included. Gould-National Batteries, Inc.

BOILERS & BOILER ACCESSORIES

Boiler Service Valves **206**

Surface blow, bottom blow-off, water column blow-off and connections are thoroughly covered in 22-page bulletin E125. Describes quick-opening and slow-opening straightway valves, angle valves, Y valves and duplex blow-off units, with complete specifications, materials of construction and dimensions of each type. Illustrations include details of design, sectional and exploded views, and explanations of valve operation. Section also describes valves for fire protection. Everlasting Valve Co.

Boiler Accessories **207**

Line of alarms, gages, trycocks and accessories described in 16-page catalog 700. Well illustrated with photographs, dimensional drawings and cross sections. Complete specifications and data given for a large variety of sizes and pressures. Easy to use illustrated index for quick reference. Wright-Austin Co.

Water Columns & Gages **208**

Complete details on recent improvement made in high-pressure gage glass inserts are contained in 20-page bulletin WG1811 (revised). Gives full information on operation, construction features, design advantages, typical arrangements, dimensions and accessories. Cutaways, diagrams, and drawings illustrate features of the units. Photographs show typical installations. Arrangements of reflecting mirrors are diagrammed and discussed. Yarnall-Waring Co.

Draft Control **209**

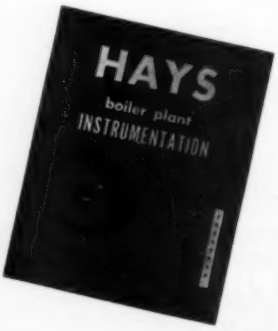
Results of extensive research into the effect of draft regulation on gas-fired boilers are presented in engineering bulletin. Graphs covering various phases of the research and recommendations are included. Bulletin also has information on regulation and characteristics of a double acting barometric draft control. H. D. Conkey Co., Field Control Div.

Smoke Recorder **210**

If you are concerned with smoke abatement, bulletins 512 and 5101 should be of interest. Descriptions, data and illustrations are presented on electric smoke recorder, smoke periscope and lens-type furnace indicator. Ess Specialty Corp.

Boiler Plant Instrumentation **204**

Is the boiler plant one of your services? You should find this 24-page publication 51-605 valuable as a guide for instrumentation problems. Arranged and indexed for quick reference, each instrument, gage and control is discussed in a brief but thorough manner and illustrated with photo, cutaway or diagram. Section on combustion control describes and illustrates control elements, controller components, operation, advantages and panels. Four pages of layout drawings and descriptions of standard control systems are a feature of this section. Useful table lists most boiler room instruments, types and functions. The Hays Corp.



KEEP POSTED

Do you have information at your fingertips when you need it? It is often said that one of the criteria of good engineering is the ability to obtain correct information when it is required. In Engineered Plant Services, due to the wide extent of this field, a diversified reference file should prove most helpful.

Many engineers have discovered a wealth of free engineering advice and experience in manufacturers' literature. Valuable data, tables and graphs are often included, and arranged in a convenient quick reference style. Many engineers therefore maintain a personal reference file of up-to-date publications, which provide considerable data oftentimes not to be found in standard textbooks or handbooks, and also information and a means of comparison on the latest products available.

To aid you in establishing a personal up-to-date reference file of bulletins and catalogs, I & P features three special departments each month. Items have been screened to present only those of value. The "Reader's Service" department, whose only function is to be of service to you, will handle your requests promptly.

(Continued on page 30)

INDUSTRY'S STANDARD STEAM DRIVE!

For Continuous or Stand-by Operation...

Here's the general-purpose turbine that meets the increasingly rigid demands of modern industry. It's the Westinghouse Type E, designed to operate reliably and efficiently where the going is tough. Regardless of operating conditions, the Type E is built to give trouble-free, economical performance for long periods of continuous operation . . . or instant operation when used as a stand-by drive.

Wrapped up in one reliable unit are the best features of all Westinghouse drives . . . plus refinements and development features which are now standard on all Type E Turbines.

Weatherproof bearing seals, corrosion-resisting gland zones, centerline support for freedom of expansion and contraction, dual protection against overspeed, floating movement of governing and trip linkages, and parts interchangeability between wheel sizes are among the many advantages built into Type E drives. J-50526

WRITE FOR THIS BOOKLET. We invite your comparison . . . *on any count.* See your nearby Westinghouse representative for the full story. Ask him for Type E Turbine Book B-3896, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

YOU CAN BE SURE.. IF IT'S
Westinghouse
TYPE E Turbines

New bulletins and catalogs

(Continued from page 28)

BUILDING HEATING, VENTILATING & AIR CONDITIONING

Unit Heaters **211**

Gas fired unit heaters, redesigned for reduced weight and bulk and faster response, are fully described and illustrated in 8-page brochure 651. Includes dimensional drawings and tables of weights & capacities. Modine Mfg. Co.

Controls **212**

Complete and informative 48-page catalog F1753-3 describes thermostats, motor-operated valves and accessories for heating, ventilating, and air conditioning applications. Combines engineering data with selection information which should aid in choosing automatic electric control equipment. Barber-Colman Co.

General Catalog **213**

Bring your quick reference file up to date with 36-page catalog PB-290. Condensed descriptions, data, applications and photos for full line of air conditioning, heating, ventilating and heat transfer equipment have been conveniently arranged for easy reference. Also lists bulletins available for more complete information on each product. The Trane Co.

Ceiling Outlets **214**

Several models of ceiling ventilators, including supply, combination supply and return, and supply with light unit are featured in 20-page catalog F-4085-1. Descriptions, specifications, and performance data are given. Illustrations include cutaways, photos and drawings. Barber-Colman Co.

BUILDING MATERIALS & MAINTENANCE

Mortar **215**

Discussing the importance of narrow, tight joints in obtaining long life where corrosive conditions exist, 4-page bulletin E27 tells how floors with joints down to ⅛ in. can be installed by using readily flowable, non-shrink mortar produced with Embeco. Gives complete specifications. The Master Builders Co.

Mastic Flooring **217**

Advantages of resilient asphalt mastic floors are outlined in a 4-page folder 23-D. Applications for specific purposes are revealed by brief discussions and photos of actual installations. Tremco Mfg. Co.

Floor Resurfacer **218**

If the floors in your plant need repair, perhaps this 4-page illustrated circular will be of value. Ready-mixed floor resurfacer made from a plastic base is featured. Literature states no drying time or trowelling is necessary. Ranco Industrial Products Co.

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Fluorescent Ballasts **219**

Two publications on fluorescent lamp ballasts are offered. The first, 20-page booklet GEA5731, explains in non-technical language how a fluorescent lamp works and the part the ballast plays in its operation. Illustrated with diagrams, the book reviews the role of the ballast in modern fluorescent lighting. Of a more technical nature, the second publication, 4-page GEA5672 deals with G-E's system of "sound-rating" its ballasts. Describes how ballasts are classified according to the amount of natural hum they emit. Explains how these ratings can be put to use, and gives a typical example of application. General Electric Co.

Water Repellent **220**

Technical treatise 126-11 on the use of silicone base materials to make masonry walls water repellent contains a study of the water repellency problem and outlines the tremendous annual damage caused by absorption of water into masonry surfaces. It discusses preventive methods and emphasizes use of silicones for this purpose. Test data is presented. The Monroe Co., Inc.

COAL, ASH & BULK HANDLING

Conveyer Belt **221**

If you have conveyer belt difficulties an illustrated 4-page folder 6915 featuring a recently developed belt may be of interest. Booklet claims many benefits for product. Raybestos-Manhattan, Inc., Manhattan Rubber Div.

Belt Conveyers **222**

"Belt Conveyers . . Industry's Bulk Handling Giant" is an interesting 24-page booklet which clearly tells of the development of belt conveyers and their present day importance. Included are photos of installations in many diversified industries. Booklet is a copy of a paper presented to ASME. Link-Belt Co.

Conveyer **223**

Unusual conveyer for transportation of fine materials is fully explained in 8-page bulletin FH-2. This conveyer may solve your dust and maintenance problems. It is completely closed and has no moving parts. Catalog explains that pulverized materials flow like water. Illustrated with drawing and photos. Fuller Co.

Belt Conveyer Carriers **224**

Belt conveyer carriers are the subject of 20-page bulletin 2C. Complete information on types for practically any bulk material handling application is given. Lists features, applications, sizes and dimensions of each style along with lubrication and maintenance data. Photographs, cutaways and drawings show full particulars of the units. Stephens-Adamson Mfg. Co.

Hopper Conveyer **225**

Literature describes conveyer designed for filling hoppers on spreader or underfeed stokers where increased capacity has been provided by extending sides of hopper. Lists advantages, applications, dimensions and specifications. New London Engineering Co.

Ash Handling **226**

"Modern Ash Handling for Modern Power Plants" is a 4-page brochure describing ash handling systems in four recently completed plants. Pumping, jetting and pneumatic methods are briefly discussed. The Allen-Sherman-Hoff Co.

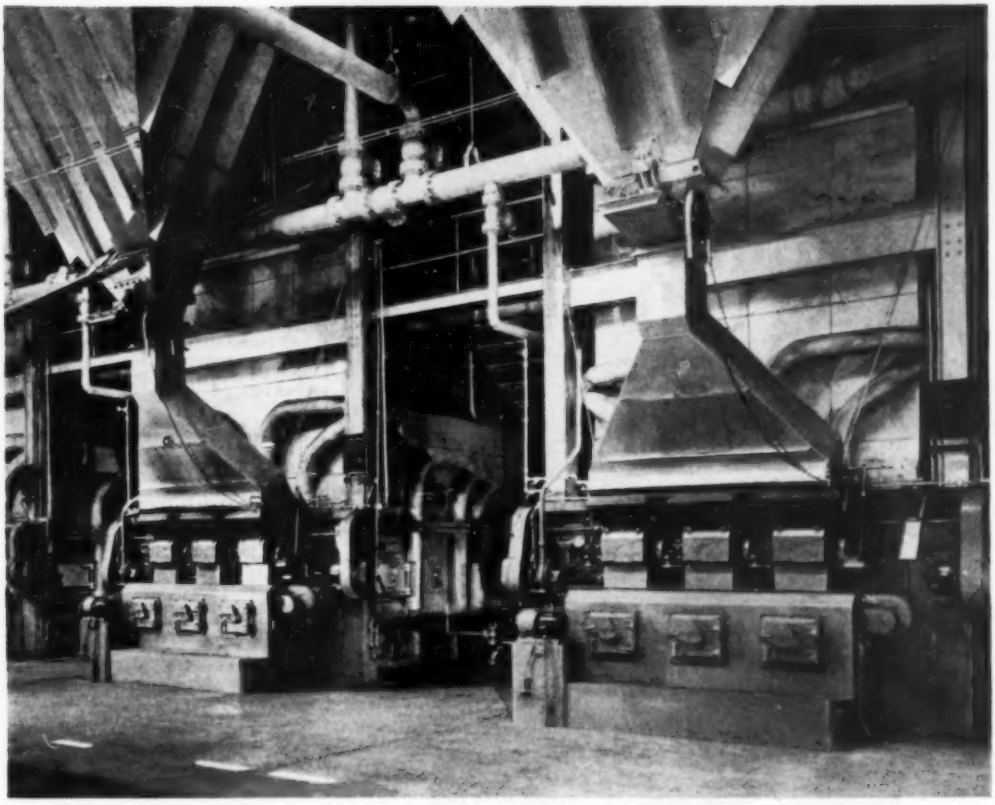
Coal Handling **227**

Ideas and suggestions for solving the coal and ash handling problems of today's power plants are presented as part of 44-page book 2410. Also contains helpful layout drawings and photographs of actual installations at both large and small public utility, industrial and public building power plants. Installations at new plants as well as boiler houses that were modernized, enlarged or improved after the original installation also are shown. Includes sections on unloading coal, auxiliary unloading, coal storage and re-

(Continued on page 32)

Weighing Systems **216**

If your problem is to control weights or rates of flow of materials in your plant, you should find 56-page brochure 841 a valuable source of information. Diversified line of weighing, batching and proportioning systems are discussed and illustrated with photos and drawings. Features, applications and engineering specifications are given. Component parts of the systems, such as electrical controls, conveyers, pulverizers, crushers, screens, and bin level indicators are also described and illustrated. Includes useful information on how to determine the valley angle of a hopper and a density table of typical solids as they occur in bulk handling. Jeffrey Mfg. Co.



HOFFMAN Industrial Stokers

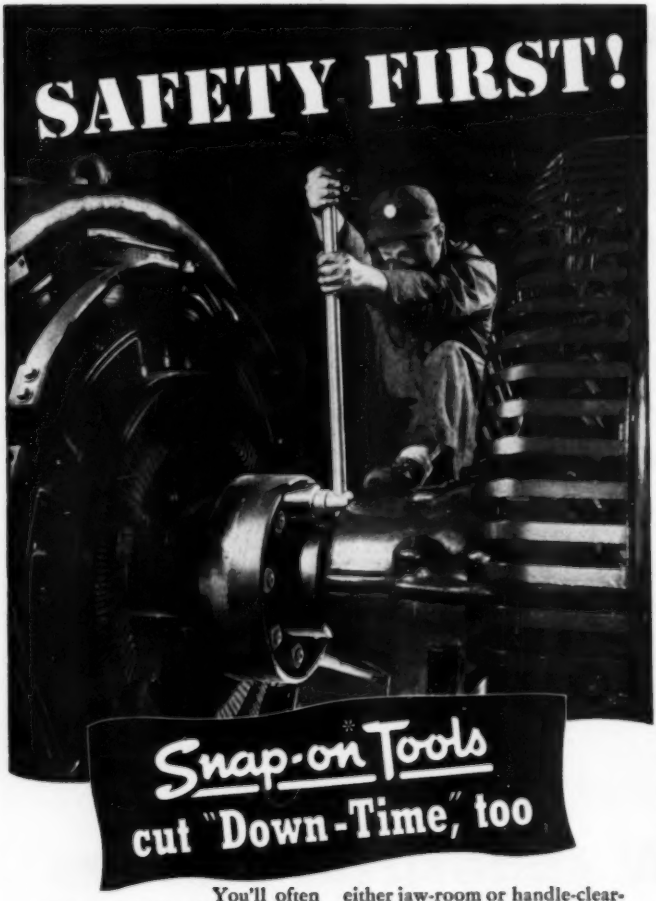
POWER DUMPING • CONTINUOUS ASH DISCHARGE

FIRST Firite SPREADER

Smoke and other stack nuisances can be controlled by close cooperation among city authorities, manufacturers of equipment, and operating personnel.

Hoffman engineers, strategically located, will gladly work with smoke inspectors and operators to correct complaints.

HOFFMAN COMBUSTION ENGINEERING COMPANY
General Offices: MARQUETTE BUILDING, DETROIT 26, MICHIGAN
Works: FAIRMONT, W. VA. and DETROIT, MICHIGAN



You'll often save enough *in labor-time alone,* to pay for the *right* Snap-on Tool to reach hard-to-get-at spots such as these generator coupling flange nuts. The more important savings in "down-time" are so much "velvet."

On this job, as you can see, there's no room for the head of a ratchet wrench, nor is there either jaw-room or handle-clearance for an open-end wrench. But a Snap-on L-53 Sliding Bar does the trick, with a safe, sure, snug fit and an easy half-turn-at-a-time action, without once disturbing the grip of the socket.

Ten to one, there are maintenance or overhaul jobs just as time-wasting, potentially, as this in your plant. And the odds are still better that there are many Snap-on Tools that would swiftly pay for themselves. Here Snap-on's nation-wide tool service can be mighty helpful!

Write for industrial catalog and 104-page general catalog!

SNAP-ON TOOLS CORPORATION
8102-A 28th Avenue
Kenosha, Wisconsin

*Snap-on is the trademark of Snap-on Tools Corporation.

New bulletins and catalogs

(Continued from page 30)

claiming, crushers, transporting and distributing equipment, ash handling equipment and water intake screens. Link-Belt Co.

Pneumatic Conveyers **228**

Booklet 6a will be a valuable addition to your reference library. Pneumatic conveyers for ash, chip and bulk handling are described and actual installations are illustrated with photos and layout drawings. This 8-page bulletin is presented in a convenient quick reference style. National Conveyers Co., Inc.

HOW TO REQUEST FREE BULLETINS

Each paragraph in this section is numbered —beginning with number 200. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out, and mail. Our Reader Service Department will handle your request promptly.

Switch Locomotives **229**

Gasoline or diesel, mechanical, torque-converter or electric drive industrial switch locomotives in 30 to 70 ton capacities are the subject of 3-color, 30-page catalog LG-52. Includes engineering specifications and informative tables for tons of hauling capacity. Section on how hydraulic torque-converters operate, and what they do, is featured. Insert, in the form of a questionnaire, is included to help in analysis of hauling needs. Also gives simple method for figuring percent of track grade. Plymouth Locomotive Works.

COMPRESSORS

Air Compressors **230**

Complete engineering data for a line of single and two stage motor-driven compressors from 250 to 1000 hp are presented in 4-page bulletin M-65. You will want these data in your quick reference file. Features cutaway view of compressor. Also illustrated with photos. Cooper-Bessemer Corp.

CONTROLS, REGULATORS & INSTRUMENTS

Non-frosting Gages **231**

Data sheet 177, describing line of non-frosting gages, is offered for your ready reference library. Cross-section drawings of transparent and reflex types are included. Jerguson Gage & Valve Co.

Instrument Panels **232**

Useful 4-page data sheet P1-2 covering a complete line of cabinet type instrument panels will help bring your

(Continued on page 34)

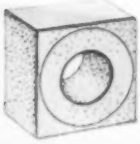
"Here's why I keep a stock of Kaocast on hand!"

The Chief Engineer of a mid-western power plant finds B&W Kaocast so *versatile* that he always keeps a ton or more on hand for miscellaneous jobs. This is only one of hundreds of plants in a list of diversified industries which are discovering practical, time-and-money-saving uses for this unique 3000 degree refractory castable. The panel at right gives a few examples.

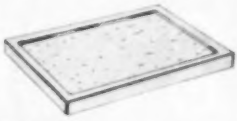
There are good reasons for these Kaocast "success stories". This jack-of-all-refractories can be molded in a hurry *by you, when you need it.* It can be cast directly in place or applied by cement gun. Kaocast not only makes possible faster repairs and eliminates the need for a large inventory of special shapes, but it also stays on the job. That's because Kaocast has high resistance to spalling and slag attack, low volume change and negligible re-heat shrinkage.

Get all the data on easy-to-use, versatile Kaocast from your B&W Field Engineer. His specialized experience is an important B&W "extra".

KAOCAST is another important refractories development by B&W engineers who have continuously established new standards in industrial furnace refractories for the past 30 years.

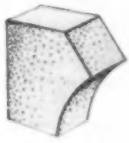


BURNER BLOCKS
Kaocast lasted 3 to 6 times as long as previous refractory. Still going strong.



DOOR LININGS
Kaocast lasted 3 to 6 times as long as previous refractory — cut installation cost in half.

TUNNEL KILN CAR TOPS
Ordinary fireclay crumbled after few trips. Kaocast lasted 30 trips without deterioration.



SPECIAL SHAPES
Kaocast special shapes cast over weekend to meet production demands.

BABCOCK & WILCOX
THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: AUGUSTA, GA.

R-407

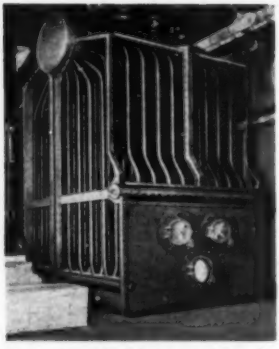
B&W REFRACTORIES PRODUCTS — B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick B&W Refractory Castables, Plastics and Mortars • OTHER B&W PRODUCTS—Stationary & Marine Boilers and Component Equipment . . . Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers . . . Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

The construction facilitates conversion from oil to coal or coal to oil with minimum cost. The boiler design provides ample furnace volume for the various fuels.

Type KS Water-Tube Boilers By Bigelow are built in sizes ranging from 20,000 to 45,000 lbs. of steam per hr. Type KL Boiler sizes range from 35,000 to 70,000 lbs. of steam per hr. Type KV Boiler sizes range from 70,000 to 100,000 lbs. of steam per hr.

Compact—Low Maintenance—Low Fuel Cost.

Write for free catalog on the Types KS & KL or on any of the boilers listed below.



Bigelow Type KS-18 during erection at the E. & J. Gallo Winery, Modesto, Calif. Capacity 26,000 lbs. steam per hr., oil fired.

BOILERS BY BIGELOW

Water Tube Boilers — Bent Tube Types • Horizontal Return Tubular Boilers • Scotch Type Boilers • Two-Pass Boilers Electric Steam Generators

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81-5

New bulletins and catalogs

(Continued from page 32)

CONTROLS, REGULATORS & INSTRUMENTS

quick reference file up to date. Unit construction is explained, and dimensional drawings covering a variety of standard cutout are featured. Photo of panel is also included. Wheelco Instruments Co.

Recorders **233**

Miniature strip chart recorders are the subject of 6-page specification sheet 769. Sheet includes complete description and specifications, and is illustrated with photos and numerous application diagrams. Minneapolis-Honeywell Regulator Co., Brown Instruments Div.

HOW TO REQUEST FREE BULLETINS

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Tachometers **234**

How to measure speeds from 2/100 to 100,000 rpm is explained in 4-page illustrated bulletin 735. Featured are several chronometric type tachometers. Handy specification chart is included. Herman H. Sticht Co., Inc.

Self-operated Controllers **235**

Complete engineering data and specifications for a line of automatic temperature and pressure controllers are presented in 4-page illustrated folder 1320. Applications such as hot water storage heater, tanks and exhaust boxes are listed. Weston Electrical Instrument Corp., Tagliabue Instruments Div.

Oscillograph **236**

Bulletin gives applications, construction details and specifications of high-speed, direct writing oscillograph. Contents of the bulletin includes the story of the chopper type amplifier which has, among other things, the effect of making the instrument completely drift-free. Also listed are applications which require the simultaneous recording of rapid transients. Offner Electronics Inc.

Telemeters **237**

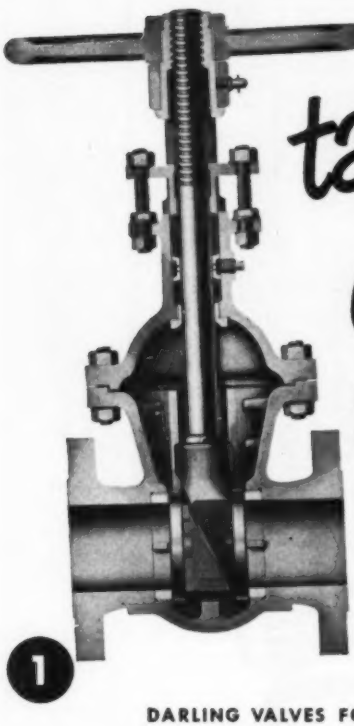
Bulletin 230-H4, 8 pages, describes the Chronoflo Telemeter, which makes possible the transmission of information and controls over a simple two-wire electrical circuit for unlimited distances. Lists features of the device, de-

(Continued on page 154)

PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

DARLING VALVES

take your choice...



FOR BETTER, LOWER COST SERVICE WITH DARLING cast steel gate valves

1

2

DARLING VALVES FOR EVERY NEED

Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

IN addition to gate valves of solid wedge design, Darling offers two other types. Both have distinctive features that prolong valve life while minimizing down time and maintenance. They're great time and money savers! . . .

1 This view shows a Darling gate valve of the fully revolving, double disc, parallel seat type. Time and again users rate it the most trouble-free, best performing gate valve obtainable today. Why? Because its unique design assures: *automatic* adjustment for valve body distortion . . . positive, easy operation . . . uniform wear distribution . . . foolproof simplicity in maintenance and reassembly . . . and service life seldom if ever equalled.

2 Take a close look at the slotted, double-grooved wedge in this cutaway view. There's little wear and tear on *these* wedge faces and seats because the slot permits compression of the wedge to compensate for valve body expansion or contraction due to temperature changes. Moreover, the double grooves, with twin guide ribs in the valve body, provide twice the usual bearing area, eliminating wedge canting and avoiding damage to the downstream seat.

SEND FOR BULLETIN

Why not get *all* the facts on these money-saving valves? Then *you* can analyze and decide whether or not you stand to gain by giving Darlings a try. Simply specify your service requirements . . . or ask for cast steel valve bulletin.

DARLING VALVE & MANUFACTURING CO.

Williamsport 9, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

Works without Attention to Furnish Clean Water —Cheap

This is the way many industrial plants solved the problem of high water bills and low water supplies.

They use Cuno FLO-KLEAN Strainers to remove trash from raw water . . . or to reclaim used process water.

Some users have saved enough to pay for their FLO-KLEANS in a few months!

The FLO-KLEAN is a large-capacity (up to 20,000 gpm), corrosion- and abrasion-resistant strainer which positively removes all solids larger than specified.*

Continuously Self-Cleaning

Operation is continuous—with never a stop for cleaning the FLO-KLEAN. This eliminates the need for a duplex installation.

Self-cleaning is accomplished by an automatic backwash system which makes a further saving of water by recycling the backwash.

So—with continuous cleaning of the cartridge and automatic top and bottom blow-down, there's nothing to worry about. FLO-KLEAN can be installed in some remote place and forgotten.

*May be specified from .030 in. down to .0025 in.

Cuno Engineering Corporation
Dept. 142F, South Vine Street, Meriden, Conn.

Please send information on Cuno FLO-KLEAN for straining raw water..... reclaiming process water....

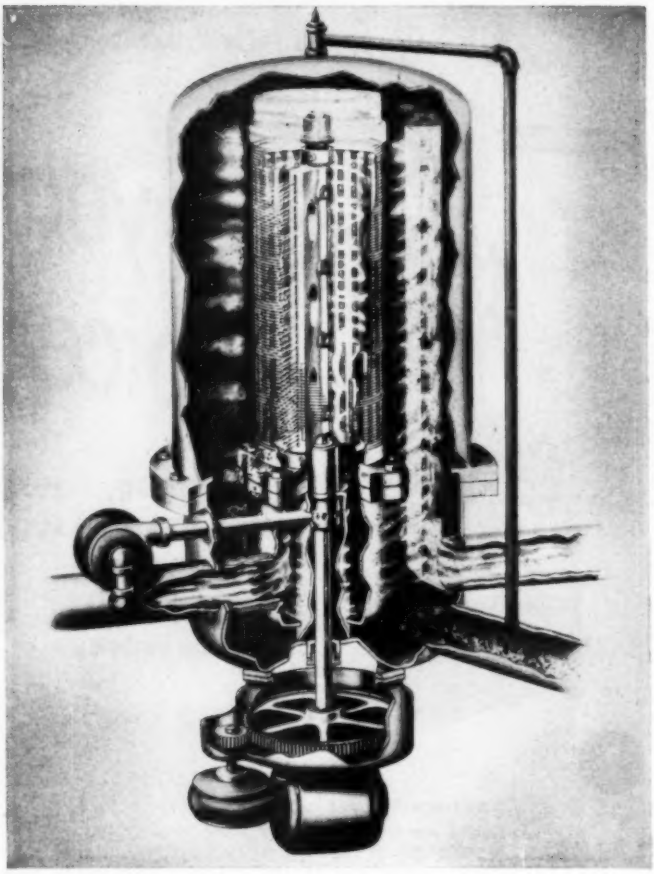
Name..... Title.....

Company.....

Address.....

City.....Zone....State.....

Please attach to business letterhead



How many times do you re-use your water?

Cut water *waste* and water *bills*. Make used process water fit for re-use by running it through a Cuno FLO-KLEAN strainer. Also—a low-cost way to clean raw river or lake water for industrial use.

CUNO

Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

Now CLIPPER Gives You A NEW CONVERTIBLE MASONRY SAW !

Here's How . . .

FIRST YOU BUY A CLIPPER MASONRY SAW

and THEN YOU ADD . . . the "CONVERTIBLE" CART

THEN USE YOUR CLIPPER "4" WAYS

① Use as a DUSTLESS Masonry Saw

② Use as a DRY Masonry Saw

③ Slip the head from your Clipper Masonry Saw into the "CONVERTIBLE" CART and you have a Handy Concrete Saw.

④ Place it in tracks and you can cut large stone slabs or transite sheets

MODEL HD
9 models from $265

GREATER JOB PROFITS THAN EVER BEFORE!

. . . at any time the cutting head of your Model HD Clipper Masonry Saw can be placed on the "CONVERTIBLE" CART (that's all you do)—you're then ready to saw concrete or asphalt patches or trenches! Imagine...switching from cutting glazed tile, concrete, face brick to sewer, water or gas lines or floor patches. No more fractures beyond removal lines—no more spalling!

But there's more . . . just set the "CONVERTIBLE" CART on Tracks and operate as a TRACK SAW. Stone slabs, Transite sheets, Plywood, Masonite, Pre-Cast Stone and large Refractories can at last be easily cut.

Try This Combination on FREE TRIAL

Order TODAY . . . on FREE TRIAL. Discover for yourself how Clipper will increase production . . . cut costs . . . increase profits. Only through the Clipper FREE TRIAL ARE you guaranteed . . . ACTUAL TEST on the JOB . . . FULL SATISFACTION . . . NO OBLIGATION! . . . If you prefer, order your Clipper Masonry Saw now . . . and the Clipper "Convertible" Cart when the need arises.

SELECT-A-NOTCH
● One man easily adjusts Cutting Head to desired height . . . Whether cutting 12" or 1" material. Operator's hands merely guide. Weight supported by rear Bar.

PRESSURE EQUALIZER
● Makes your blades last longer . . . Because Equalizer Spring automatically cushions blade pressure whether cutting HARD or SOFT materials. Outstanding for blade economy.

ADJUST-A-CUT CONTROL
● Pull the knob—and the Cutting Head is free for finger-tip setting at any desired angle. Release the Knob—and Head is locked in the desired position.

SAVE-A-BLADE DIAL
● Just turn the Save-A-Blade Dial to the material hardness and the Pressure Equalizer Spring automatically sets the tension—guarantees faster cutting and longer blade life.

Clipper

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"COAST-TO-COAST"

MAIL THE COUPON TODAY!

Serving the World as the World's Largest Manufacturer of Masonry Saws

CLIPPER MANUFACTURING COMPANY
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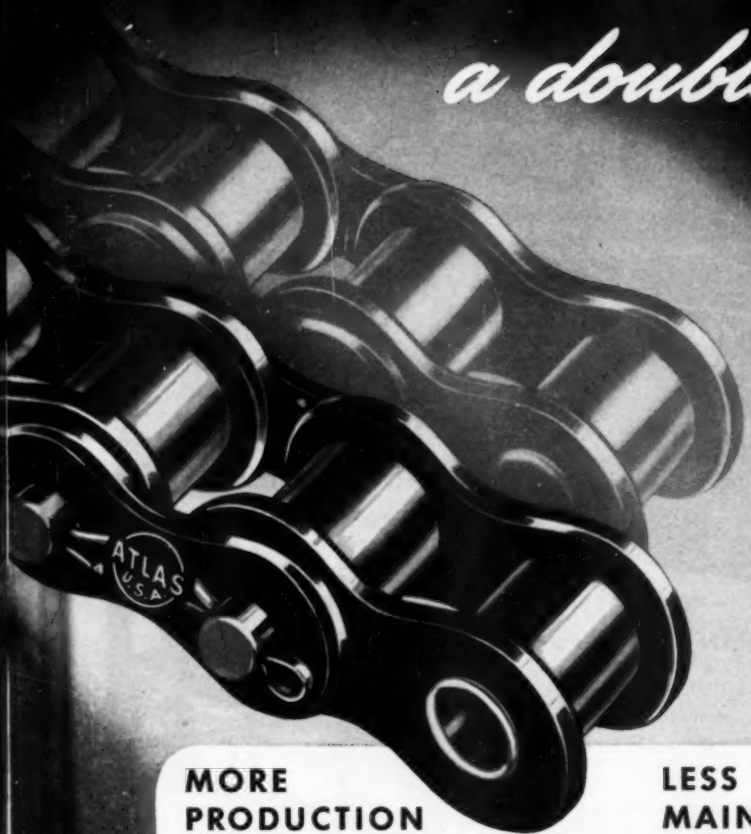
CHAIN THAT LEADS *a double life!*



MORE PRODUCTION

Boosting output of present drives! Atlas Roller Chain is bringing this benefit to plants everywhere.

That's because Atlas Roller Chain provides a positive sprocket grip which makes possible the delivery of full rated horsepower without slippage or friction.

This means that your machines can run at full rated speeds and give greater output . . . with Atlas on the drive.

LESS MAINTENANCE

Here's why: The bushings and pins are case hardened by the Atlas Nicarb Process which provides greater inherent strength. Link plates and rollers are also made of tough, heat-treated alloy steel.

This means better chain performance . . . less chain maintenance.

For maximum production plus long, trouble-free service, install Atlas Roller Chain! Write today for the new Atlas Catalog and Handbook No. 51-I P.

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PHILADELPHIA 24, PENNA.

ATLAS

ATLAS ROLLER CHAIN

Here's Why You Get

LOWER HIGH-PRESSURE PUMPING COSTS

with this distinctively new

Class HMTA

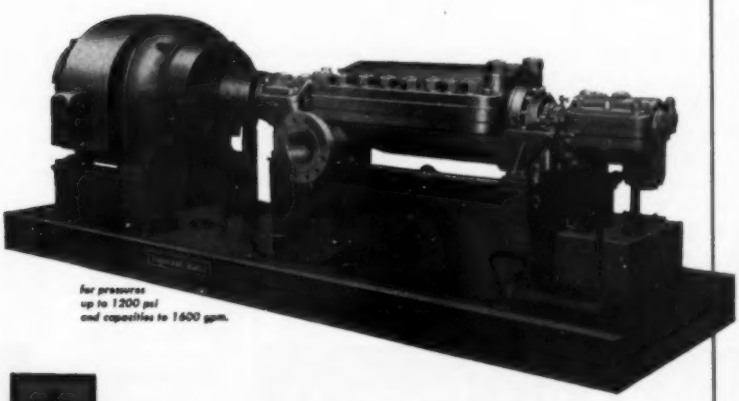
multi-stage centrifugal pump

Check the many distinctive features of Ingersoll-Rand's Class HMTA high-pressure centrifugal pump. See how they all add up to important long-range savings in installation, operation and maintenance. For here is the completely modern answer to the problems inherent in high pressure pumping service—a pump that's designed around the latest advances in hydraulic engineering.

Operating efficiencies stay higher, longer—because all running clearances are proportioned for minimum wear and materials are carefully selected for dependable performance. Maintenance is easier—and there's less of it—with simpler, more rugged construction and greater accessibility throughout. And spare parts inventories are lower due to increased interchangeability between stages.

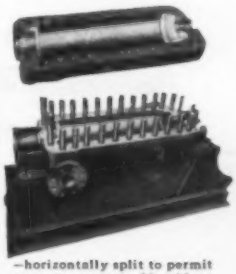
HMTA pumps may be equipped with the Cameron Shaft Seal—and with sleeve or ball bearings, as desired.

Your nearest I-R representative will be glad to give you complete information. Or write for your free copy of Bulletin No. 7233.



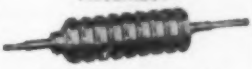
for pressures up to 1200 psi and capacities to 1600 gpm.

STRONG, SMOOTH-BORE CASING



—horizontally split to permit access to rotor assembly without disturbing piping connections.

UNIT-TYPE ROTOR ASSEMBLY



—including impellers, wearing rings, and stationary channel rings with interstage liquid passages. All elements self-aligning, all precision-machined for high sustained efficiency.

POSITIVE INTERSTAGE SEALING

—at all temperatures and pressures is provided by corrosion-resistant, metallic rings which form the fit between channel rings and casing. These rings form the most efficient, practical seal yet devised, contributing to the higher efficiency of the HMTA.

MULTIPLE-VOLUTE DESIGN

—assures complete radial balance of impellers over entire range of pump operation.

These and many other new HMTA features add up to:

- GREATER DEPENDABILITY
- HIGHER SUSTAINED EFFICIENCY
- LOWER MAINTENANCE COST

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CAMERON DIVISION 690-10

CONDENSERS • PUMPS • COMPRESSORS • ROCK DRILLS
AIR & ELECTRIC TOOLS • GAS ENGINES • DIESELS

Which **one** counts most?

Of all the 2708 men and women who make up Bell & Zoller Coal Company, *no single individual is most important!* Just as in any other business, coal production takes a lot of people doing a lot of different things to keep the ball rolling. And it takes teamwork too. Serving the folks who buy Bell & Zoller coals is a job in which each miner, driller, loader, clerk, salesman and executive plays a vital part. Every one of them—and their families, too—have an important stake in how well the job is done.

Ours isn't exactly a huge organization, nor is it a small one, by any means. But man for man and woman for woman, we don't know of one *anywhere* that does a better job of working together to see that every customer gets the utmost of service and satisfaction.

BELL & ZOLLER COAL COMPANY

BELL BUILDING, CHICAGO 1, ILLINOIS

ST. LOUIS • NASHVILLE • OMAHA • MINNEAPOLIS

Sixty-Six Years of Service to Coal Users

Producers of ZEIGLER, MOSS HILL, ORIOLE, MURDOCK, and BUCKHORN Coals

Sales Agents for
Mulberry Hill Coal Company
Freeburg, Illinois

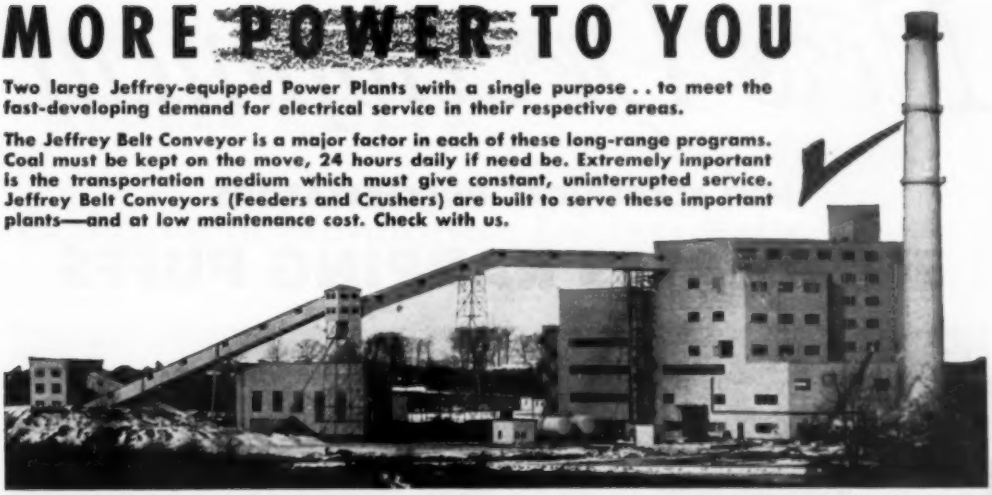
Otter-Eagle Coal Company
Lockwood, West Virginia

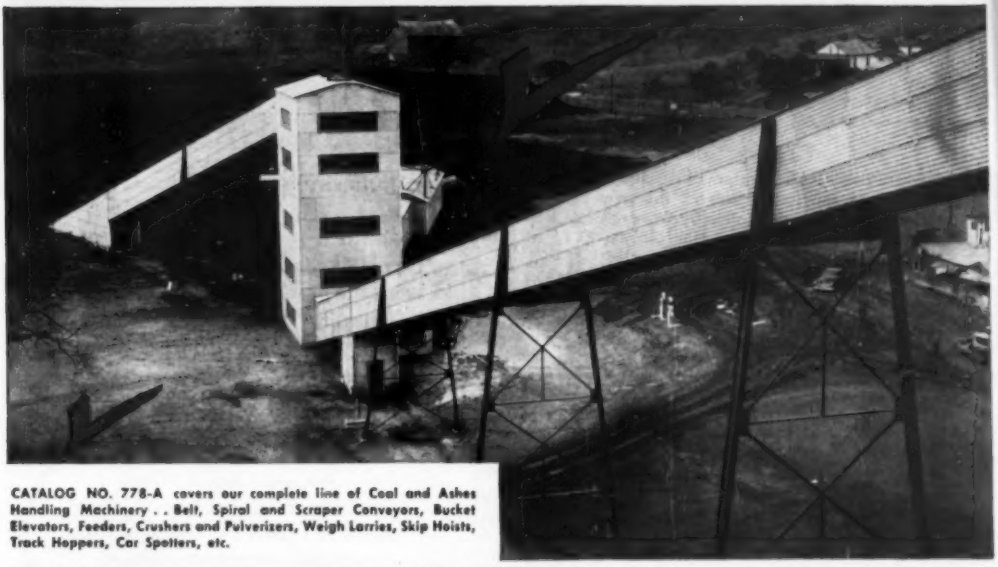
Boone County Coal Corporation
Sharples, West Virginia

MORE POWER TO YOU

Two large Jeffrey-equipped Power Plants with a single purpose . . to meet the fast-developing demand for electrical service in their respective areas.

The Jeffrey Belt Conveyor is a major factor in each of these long-range programs. Coal must be kept on the move, 24 hours daily if need be. Extremely important is the transportation medium which must give constant, uninterrupted service. Jeffrey Belt Conveyors (Feeders and Crushers) are built to serve these important plants—and at low maintenance cost. Check with us.





CATALOG NO. 778-A covers our complete line of Coal and Ashes Handling Machinery . . Belt, Spiral and Scraper Conveyors, Bucket Elevators, Feeders, Crushers and Pulverizers, Weigh Larries, Skip Hoists, Track Hoppers, Car Spotters, etc.

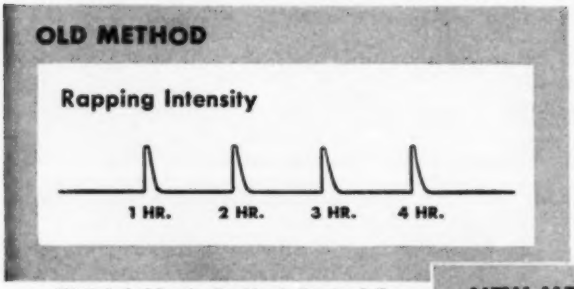
THE JEFFREY MANUFACTURING COMPANY
ESTABLISHED 1877
915 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

New Development

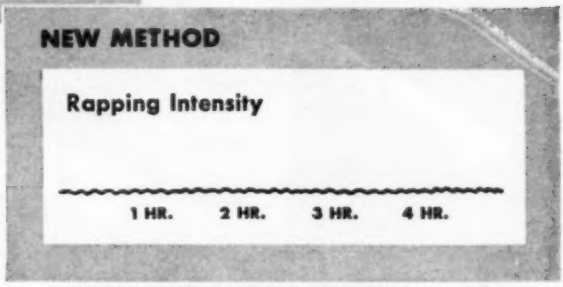
FOR ELECTRICAL PRECIPITATORS

ELIMINATES RAPPING PUFFS



Old Method of Rapping Resulting in Rapping Puff

Here are two simple diagrams that clearly demonstrate the importance of the new method of rapping developed by Research Corporation. The first shows the old way in which dust is shaken loose from electrodes at *periodic* intervals, causing intermittent puffs or clouding.



New Method of Continuous Rapping Eliminating Rapping Puffs
Rapping Intensity

This second diagram illustrates the new scientific method of cleaning electrodes. It involves continuous or sequential rapping, every minute or less, at a controlled vibrational intensity. This converts precipitation from a batch operation to a *continuous and uniform process.*

This is another major contribution by Research Corporation to the field of electrical precipitation. Constant research and development work for the past 39 years has resulted in many other improvements over the first Cottrell Precipitator. These advances plus the unequaled experience gained through over 1000 installations, listed at right, assure you of a profitable solution to your specific problem.

RESEARCH CORPORATION INSTALLATIONS

55 Carbon Black Plants
208 Metallurgical Installations
215 Acid Plants • 34 Paper Mills
293 Detarring Installations
251 Power Stations
86 Steel Plants • 114 Oil Refineries
and Miscellaneous Installations

Want to know more about the new Rapping System? Bulletin FA contains additional data. Send for your copy.

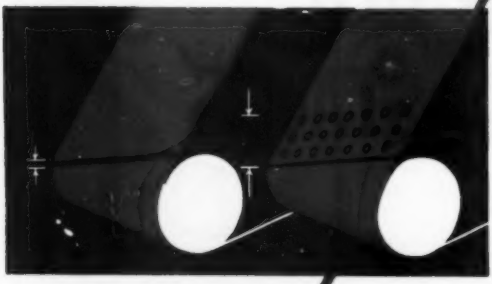
RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois
Bound Brook, New Jersey

RC-139

"RUBBER RIVETS"

Exclusive in Manhattan Endless Belts



ELIMINATE SPLICE FAILURES

You get much longer life out of Manhattan's Endless Flat Belts because of our exclusive use of "Rubber Rivets" in splicing the cover. In ordinary endless belts the stress of flexing over small pulleys concentrates where the cover is spliced. Failures of these belts start at this point of greatest weakness • With Manhattan Belts the stress is dissipated over a wide area. The difference is illustrated above. During manufacture "Rubber Rivets" are inserted at pre-determined points through the cover. Vulcanizing then makes these rivets an integral part of the belt, eliminating possibility of separating • This is the "Extensible-Tip" exclusive with Manhattan. This plus feature in all Manhattan Endless Belts gives you longer belt life and lower belt cost . . . typical of the R/M engineering that also saves you money in hose, V-belts and conveyor belts • *Ask your R/M distributor for your copy of our "Exclusive Features" book.*

R/M

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Flat Belts · V-Belts · Conveyor Belts · Hose · Roll Covering · Tank Lining · Abrasive Wheels

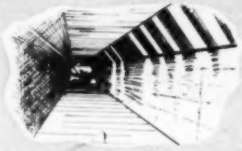
Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Packings • Brake Linings • Brake Blocks Clutch Facings • Asbestos Textiles • Sintered Metal Parts • Bowling Balls

WHERE TO USE LUMNITE IN POWER PLANTS

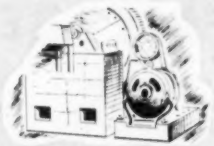
Steel Stack Linings

Ash Pit and Cinder Catcher Linings

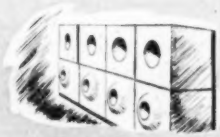
Coal Bunker Linings



Flue and Duct Linings



Overnight Structural Concrete



Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

Linings made with LUMNITE*

PUT NEW LIFE IN OLD STEEL STACKS

A Lumnite-Haydite lining gives this National Tube Company stack a new lease on life. One of five stacks recently lined, it is now protected against corrosion and the abrasive action of high-velocity gases and fly ash, especially in the breechings. Drafts will be boosted, too, because the lining is smooth and jointless, with good insulating qualities.

Stacks are just one of the profitable uses for insulating concrete made with Lumnite calcium-aluminate cement. Lumnite, with suitable aggregates, is ideal for baffles, furnace walls, arches, door linings...virtually anywhere that heat is a problem.

Easily Installed—Maintenance Reduced. Lumnite linings may be readily troweled into place or "shot" on by cement gun. Thus, there are no small units to work loose; maintenance is lessened. When repairs are necessary, they can be made quickly and cheaply, for Lumnite reaches full service strength in 24 hours or less.

For further information, write Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

1P-L-10R

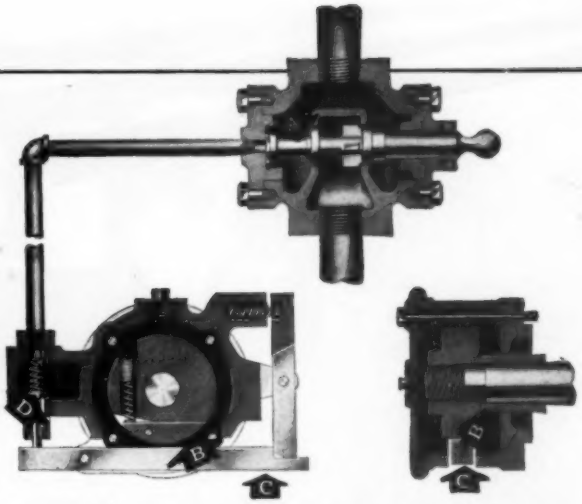
ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

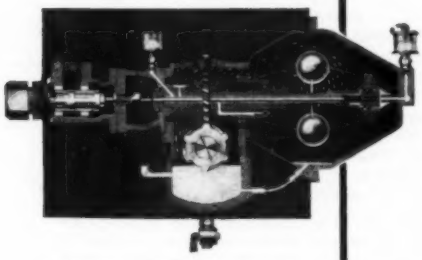
A UNIVERSAL ATLAS PRODUCT

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 181 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

best
. . . FOR OUTDOORS

● Steam Trapping presents special problems when the condensate cannot be returned to the boiler but is wasted.

Ordinary steam traps then cause much heat loss by discharging condensate at high temperature.

If the equipment is outdoors, there is the further problem of preventing freeze-ups in winter.

On board ship the presence of severe vibration further limits the choice.

ALL THESE DIFFICULTIES CAN BE OVERCOME, BY INSTALLING

SARCO LIQUID EXPANSION STEAM TRAPS NO. 871

This trap discharges condensate to atmosphere at below 212°F regardless of inlet pressure (up to 350 psi). When cold, its large discharge valve is wide open. No special protection against freezing is needed.

AFLOAT use No. 871 on heating coils of tankers and liquid cargo carriers; also to assure dry steam to whistles, winches and other deck machinery.

ASHORE use No. 871 on docks, piers and in railroad yards and terminals; also on outdoor storage tanks and tracer lines or pipe line heaters.

Full details in new bulletin *No. 260.*

NOTE: A special model is available to protect mechanical traps against freezing. It can be set as low as 40°F. Ask for drawing S-1350 on Sarco Thermic Drain.

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N.Y.
SARCO CANADA LTD., TORONTO 5, ONTARIO
Branches in Principal Cities

350

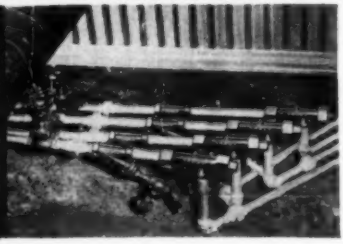
Only Sarco makes Liquid Expansion Traps which use the uniform force of oil expansion to operate a single seated valve of stainless steel.

This valve has a throttling action to provide a continuous flow, but shuts off tightly against steam.

Steam jacketed asphalt lines and a jacketed pump at Globe Roofing Products Co., Whiting, Indiana, are drained by Sarco No. 871 steam traps.

Condensate is discharged to the sewer without excessive heat loss.

Note Sarco Strainers protecting the trap valves against dirt and scale.



Have you ever seen a flying 'dust' man?

...Then ask a Buell Engineer to determine the most efficient, most economical method of collecting nuisance dust —for you

When we're called upon to solve a fly-ash problem, Buell engineers plan with precision, yet move with surprising speed.

Quickly they can pin-point your major cause of escaping dust...analyze the dust as to particular characteristics...Then, with a sureness that comes only by experience, they will recommend, design and build the Dust Collection System that will most efficiently and economically do the job.

The result? Employee morale goes up. Plant-community relations reach new and more favorable levels.

Buell engineers—a highly skilled group of industrial "dust" men—are backed by more than 200 man-years of experience in the science of dust collection. For full information write today. Ask for the new, informative Buell 'Dust Collection' bulletin. Buell Engineering Co., Dept. 90-A, 70 Pine Street, New York 5, N. Y.

Buell van Tongeren Cyclones take the guesswork out of efficient fly-ash collection.

C. E. ROSENBERG A. R. P. S.

ELECTRIC CYCLONIC

HIGH-EFFICIENCY CYCLONES • ELECTRIC PRECIPITATORS
TYPE "LR" COLLECTORS • LOW DRAFT LOSS COLLECTORS
SPECIAL PURPOSE COLLECTORS • DUST HOPPER VALVES

buell

ENGINEERED EFFICIENCY IN DUST COLLECTION

CHAPMAN

Steel Valves Score on all 3 Points

1

CHAPMAN STEEL VALVES have the high precision ratings of custom-made valves — but the economy of production-line manufacture.

2

CHAPMAN STEEL VALVES are made exclusively from quality-controlled steels developed and produced in Chapman's own foundries under control of Chapman's own outstanding metallurgists.

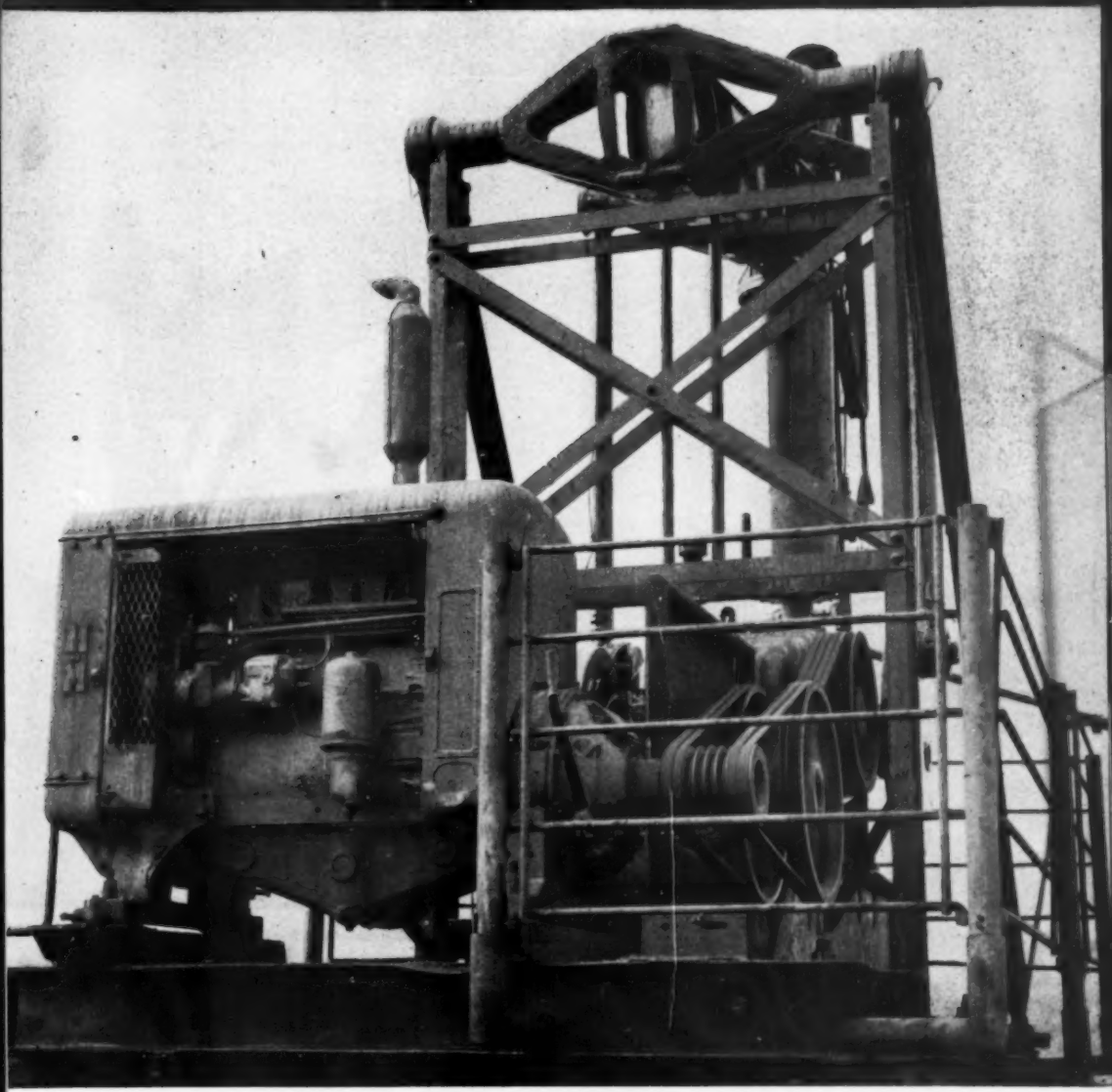
3

CHAPMAN STEEL VALVES are designed to equal or surpass — A.S.A. and A.P.I. Standards in all pressures and temperature ranges.

Be sure to see Chapman first whenever you need steel valves — gate, globe, angle or check. As a result of Chapman's long years of research and experience, they are tops in every respect.

The Chapman Valve
MANUFACTURING COMPANY
INDIAN ORCHARD, MASS.

B.F.Goodrich GROMMET BELTS AT WORK



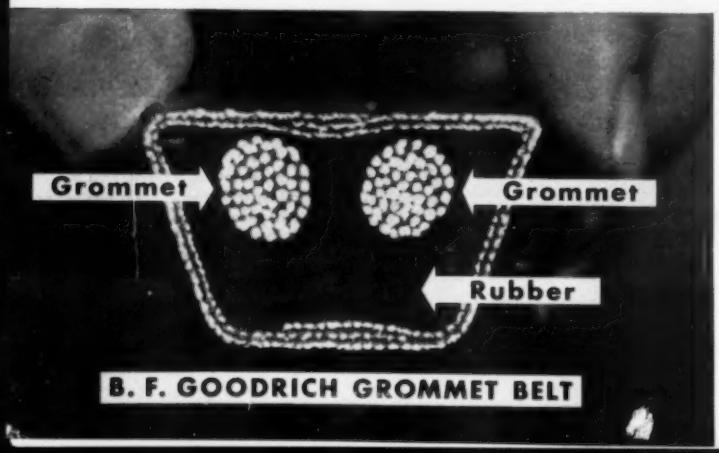
Man missing because oil well is in isolated location, pump must run itself with only periodic inspection.

To start trouble stop pump

When this oil well pump stopped, sand seeped in and clogged the pipe below ground. Then costly trouble began—pipe had to be pulled from the well and the sand cleaned out. When ordinary belts were used they wore out in 6 weeks or less—some lasted only 3 days! They couldn't take exposure to weather, oil or stand the weight of a 160 pound "floating pulley". It took a new kind of belt to solve this problem—as shown on the following page.

Oil well pump (continued)

"Floating pulley" suspended only by belts pulling in opposite directions added problem of weight on this hard drive.



ALTHOUGH practically all other makes of V belts had been tried, only B. F. Goodrich grommet belts solved the problem described on the preceding page. The B. F. Goodrich grommet belts now used on this job had given not just 3 days or 6 weeks but over 6 *months'* service and were still going strong at last report. BFG belts are now used almost exclusively because of reduced loss of pumping time, lower labor costs and lower belt replacement costs.

20 to 50% Longer Life

Patented grommet V belts by B. F. Goodrich represent the only basic im-

provement since invention of the V belt. Belts last 20 to 50% longer, depending on service. (The more severe the service the greater the increase over ordinary belts.)

What is a Grommet?

A grommet is like a giant cable except that it's endless—a cord loop built up by winding heavy cord on itself. There is no overlapping cord *section* as in all ordinary belts. Most belt failures occur in these sections where cords overlap!

All Cords Put to Work

Each grommet and every part of a grommet carries its share of the load. In ordinary belts under high tension the center cords "dish" because tension is greater near the driving faces. Dished cords are doing less work, not pulling their share. There are no cords in the center of grommet V belts, there is no dishing—therefore much more strength in proportion to cord volume.

Better Grip, Less Slip

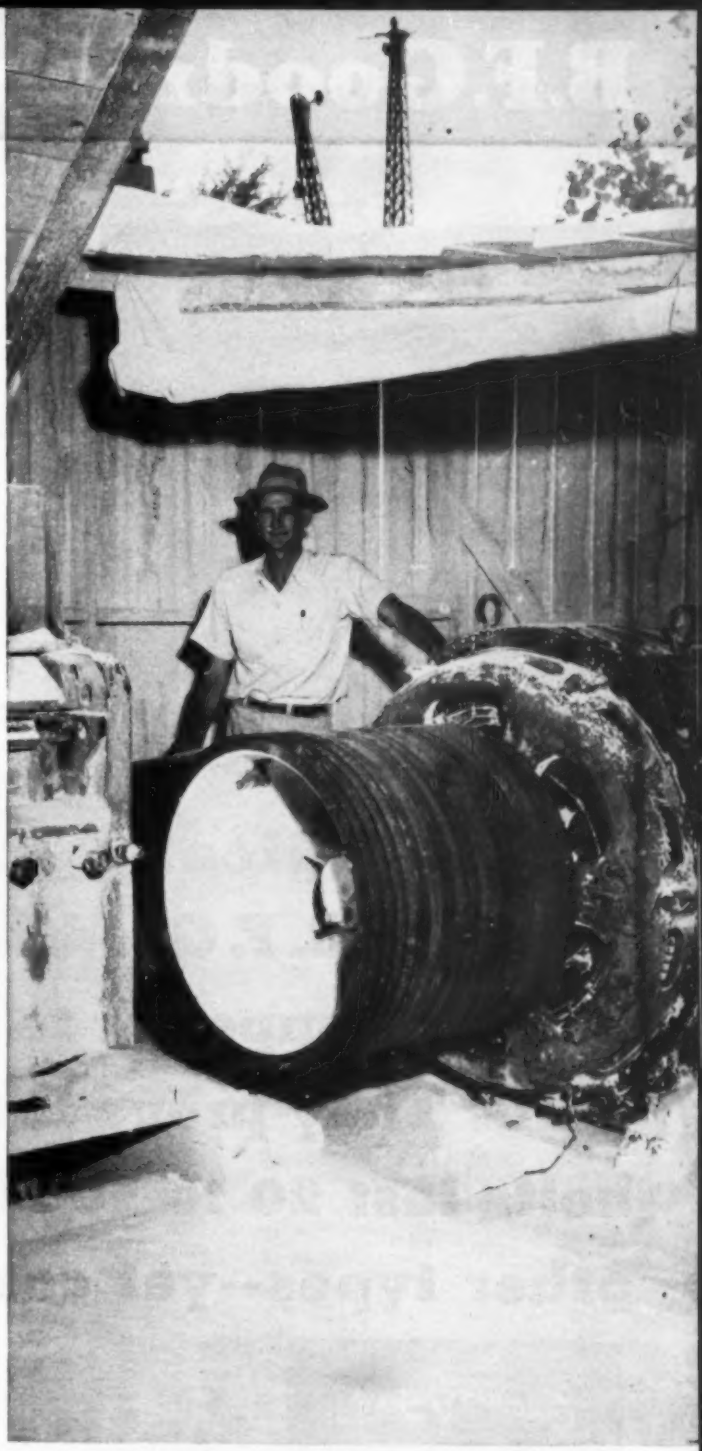
Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor. Because there is less slip there is also less surface wear.

They Cost No More

You save belt costs because belts last longer, save production costs because machines keep running with fewer interruptions, save maintenance costs because they need less attention, yet cost not one cent more than others. Grommet belts are made in C, D and E sections. They are patented by B. F. Goodrich. No other V belt is a grommet belt (U. S. Patent Number 2,233,294).

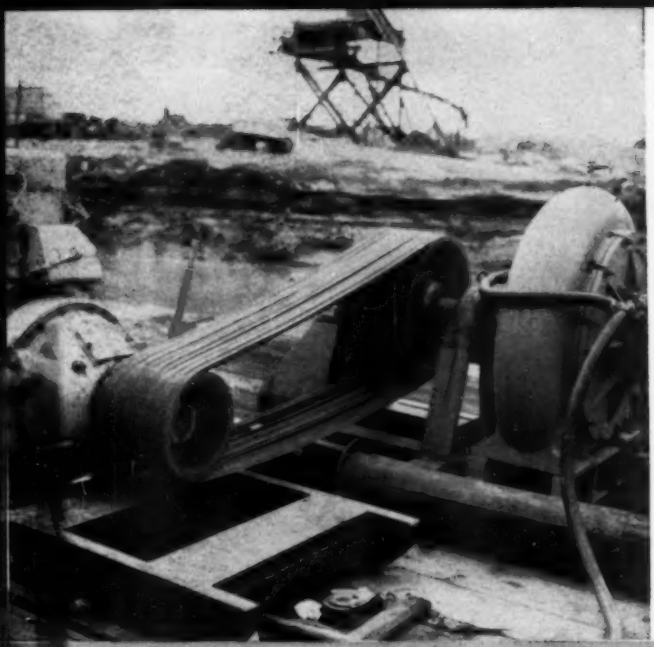
Slippery driving ➸

Carthage Marble Corporation, Carthage, Missouri had a belt drive problem on a rock crusher due to slippage. Limestone dust mixed with rain, fog or other absorbed moisture makes a surface so slick that ordinary V belts couldn't grip it. When B. F. Goodrich grommet V belts were installed slippage stopped. Reason—BFG grommet belts are more flexible. They "fit the pulley better" and so have ⅓ more gripping power than ordinary belts. The B.F.Goodrich grommet belts operate the crusher more efficiently —and reduced belt cost because the BFG belts outlast others by 20 per cent!



As rubber-muscled jaw chews up marble, limestone "snow" makes slippery driving.

B.F.Goodrich GROMMET BELTS AT WORK



New belt changes rules

In Pilsner, Nebraska, the O'Brian Sand & Gravel Company found a belt that worked just opposite to the rules for most belts. Ordinary V belts had to be under great tension in order to turn a heavy sand pump. But the tight fit pressed sand and gravel into belts and pulley causing serious wear on both in addition to bearing wear in the motor. When B. F. Goodrich grommet belts were installed it was found they gave good gripping action even though not tightened. The abrasive wear was cut down. Now, belt and pulley life are doubled—heavy bearing wear in the motor is eliminated.

If these belts got "tight" there'd be a headache on the way!

These typical examples tell you why B. F. Goodrich grommet belts are superior to ordinary V belts. They prove that grommet belts last 20 to 50% longer than other types—yet cost no more.

Grommet V Belts BY
B.F.Goodrich
FIRST IN RUBBER

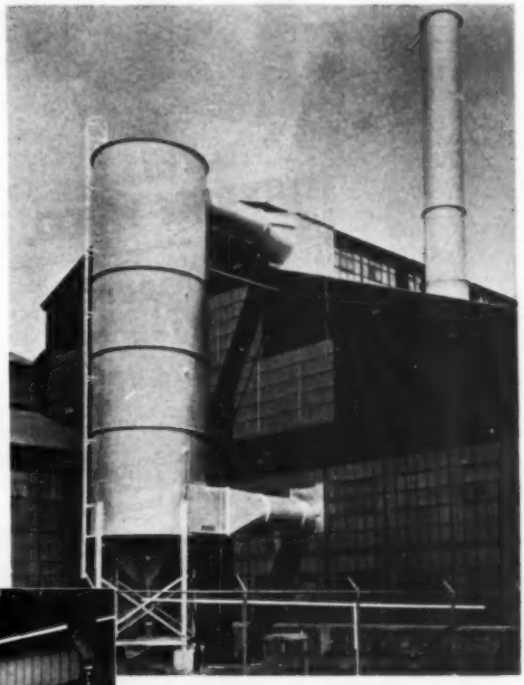
The B. F. Goodrich Company, Industrial Products Division, Akron, Ohio

YOU MAY BE PAYING FOR A MULTI-WASH SYSTEM

if you don't control Dust and Fumes

CUTS MAINTENANCE COSTS

Yes—you may be paying for a Multi-Wash Dust Collecting system without knowing it. Did you ever think of the cost of roof maintenance—of gutter and stack replacement—of the deterioration of machinery due to the acid and abrasive action of dust and dirt particles? Upkeep cost of these facilities alone could very easily pay for a Multi-Wash system and return profits over a period of time.

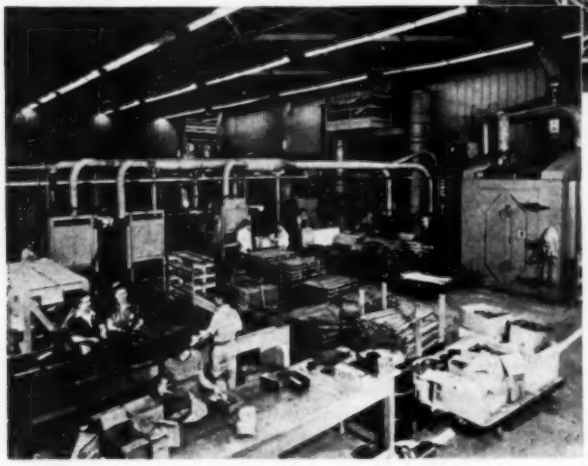


SALVAGES BY-PRODUCTS

When we say "return profits" we mean that some industries have recoverable materials that Multi-Wash will collect for reuse in processing or in some cases the original product is salvaged for extra sales. Here again the Multi-Wash Collector can be an investment that not only pays for itself but returns dividends as well.

MINIMIZES EMPLOYEE ABSENTEEISM

Eliminate the health hazard of impure, dust laden air and you have less lost time due to employee illness, less time off for observation and treatment in your plant hospital, production will run more smoothly and efficiently, too.



IMPROVES MANAGEMENT RELATIONS

Employee and management troubles in some cases have been traced to improper provision of healthful working conditions. Industry must not only consider employee welfare but their own welfare. Public opinion today is conscious of air pollution and its damaging effect, so why not investigate the Multi-Wash Collector System and make your public relations job easy on yourself.

PRODUCTS:

Multi-Wash Collectors • Uni-Flo Standard Hoods • Uni-Flo Compensating Hoods • Uni-Flo Fractionating Hoods • Water Curtain Cupola Collectors • Ductwork • Velocitrap • Dust Separators • Entrainment Separators • Settling and Dewatering Tanks • "Wear Proof" Centrifugal Slurry Pumps

CLAUDE B. SCHNEIBLE COMPANY
P. O. Box 502, Roosevelt Annex
Detroit 32, Michigan

SCHNEIBLE
MANUFACTURERS • ENGINEERS • CONTRACTORS

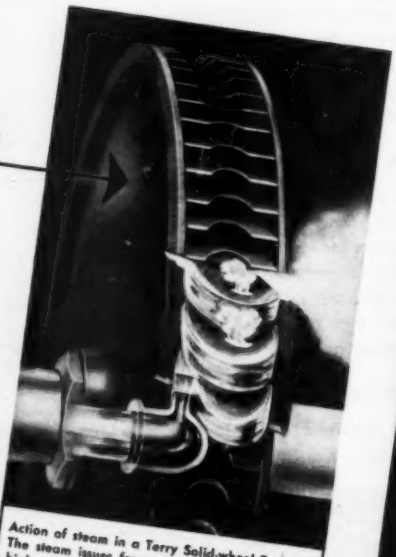
TERRY

THIS TURBINE WHEEL

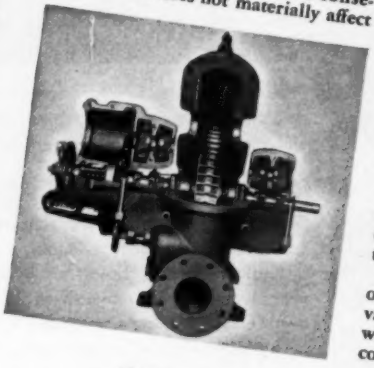
has no parts to loosen or work out

The rotor of the Terry Solid-wheel Turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to become loose or work out.

The power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Hence, wear of the blades is of little consequence, as it does not materially affect horsepower or efficiency. There is practically no end thrust since the steam enters and leaves the wheel in a direction at right angles to shaft.



Action of steam in a Terry Solid-wheel Turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.



This is only a small part of the story of the many advantages of the Terry Solid-wheel Turbine. Write for complete details.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

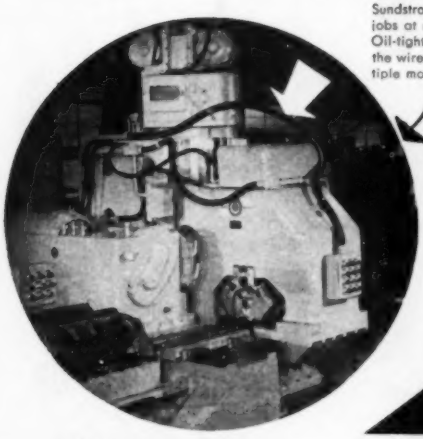
TT-1189

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

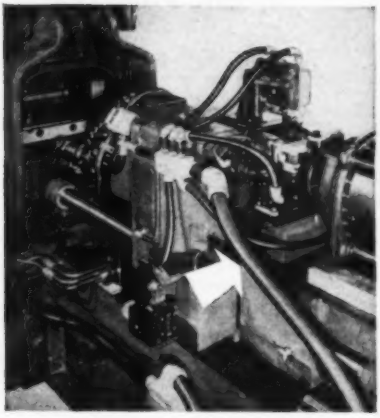
To make the wiring as good as the machine

SEALTITE FLEXIBLE CONDUIT



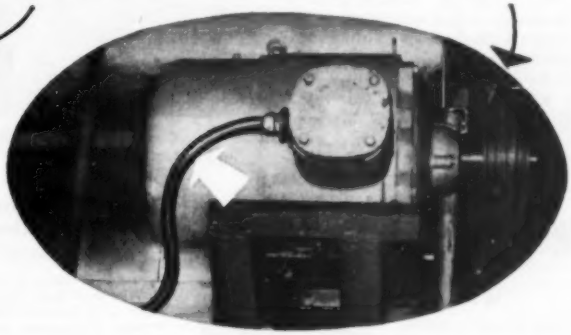
Sundstrand Milling Machine doing several jobs at once on automobile engine blocks. Oil-tight Sealtite Flexible Conduit protects the wires which energize the machine's multiple motors.

The motor-drive and control wiring on this American Laundry Machine, snug and safe in Sealtite Flexible Conduit, is securely protected against steam, water and chemicals.



Barnes "Automatic" machine tool for drilling and finishing automobile engine blocks. Sealtite Flexible Conduit carries wiring to motor and control relays operating machine turret.

Sealtite Flexible Conduit encloses motor leads on this California Packing Corporation canning plant conveyor . . . safeguards wiring from damage by fruit acids, provides flexibility for belt take-up.



For sure protection of machine wiring, run it in Sealtite* Flexible Conduit. Sealtite — with a liquid-tight synthetic jacket over strong, flexible galvanized steel tubing — can resist impact, abrasion, oil, water, steam, chemicals, etc. Its flexibility simplifies connections, especially where small or infrequent movements are involved.

Sealtite comes in long random lengths, is easily cut and assembled on the job. It uses standard rigid conduit fittings, is available from your electrical supply house. Bulletin C-188 will tell you how Sealtite's flexibility can solve many wiring problems. Send for it now. The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Company, Ltd.

61288

for **flexible, liquid-tight** electrical conduit . . . specify

SEALTITE AN ANACONDA® PRODUCT

*Trademark

So much easier... It's used more often

More people use Worthington's QD sheave than any other . . . because it's *easier.*

It's the only one on the market that gives you the choice of mounting in two pieces or preassembled.

It's the only one that makes switching sheave sizes really easy—the hub stays put, there's no realignment problem.

It's the only one with a *lock* to keep the shaft key from drifting.

You'll find it's *stronger,* too. Worthington is the only manufacturer to design each size individually for the load—rather than to proportion all sizes from one design. I-beam spokes carry heavier load with less weight.

Put Worthington QD on your drives and take a load off your men. Hubs and sheaves are available in a wide range of sizes and HP.

Worthington distributors carry complete range of stock sizes. The QD design is also licensed to other sheave manufacturers with dimensions standardized for interchangeability.

Write for Bulletin V-1400-B7F. Worthington Pump and Machinery Corporation, Multi-V-Drive Sales Division, Buffalo, N. Y.

1. Light hub goes on first . . .

2. Then heavier rim slides on

3. Or mount both hub and rim together

Worthington QD

Trade Mark Pat. No. 2369821

ORIGINAL TAPERED CONE-GRIP SHEAVE

Most Widely Used Hub and Rim Combination

Split hub is clamped to shaft. Heavier taper-bored rim slides easily over tapered hub—no keyway obstruction on cone surface. Positive press fit on shaft. Large, long pull-up bolts also used as jack screws to remove rim.

WORTHINGTON

THE GOOD RIGHT HAND OF INDUSTRY

POWER TRANSMISSION: sheaves, V-belts, variable speed drives

PUMPS: centrifugal, power, rotary, steam

AIR COMPRESSORS: water-cooled, air-cooled

MV.1.8A

How to speed up speed changes

an idea "Kicked in" by a WORTHINGTON DISTRIBUTOR

Pye-Barker Supply Co. of Atlanta comes through with *this* idea.

Many of its textile mill customers receive orders for yarns of different sizes. In processing these different sizes, speed changes—particularly on spinning frames—must be made often and quickly.

Pye-Barker, Worthington distributor, had the answer—Worthington QD sheave—the sheave that lets you change rims for speed variation without disturbing alignment. Why? Because the hub stays in place and the new sheave bolts easily and quickly in proper alignment.

To make the operation even faster, the textile mills painted the various rims a different color, one for each speed variation required—assuring the right rim, the right speed, and proper alignment.

NONPAREIL
TRADE MARK
Turbine Oil

12-year-old oil...good as new

• When a midwest municipality placed this equipment in service back in 1939, NONPAREIL Turbine Oil made up the original fill. During this 12 years of service the acidity number has never exceeded 0.09 mg. KOH/gm. Low acidity has meant low turbine maintenance costs. Make-up requirements have remained at a minimum.

When a second turbine was installed in 1950, NONPAREIL's performance record left no question in the minds of plant operators concerning the selection of an oil. NONPAREIL again made up the original fill. As in every case, these plant operators received a written guarantee that NONPAREIL would last as long as the turbine itself—that it would never exceed an acidity of 0.15 mg. KOH/gm.

For your own turbine installation, new equipment or old, operating economy begins with the installation of NONPAREIL Turbine Oil. A Standard Oil lubrication specialist can show you records covering up to 23 years of continuous operation with NONPAREIL Turbine Oil, and he can show you how to put the advantages of NONPAREIL Turbine Oil to work in your own plant. Call your nearest Standard Oil Company office, or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

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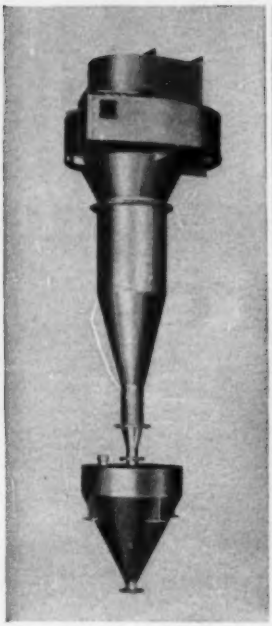

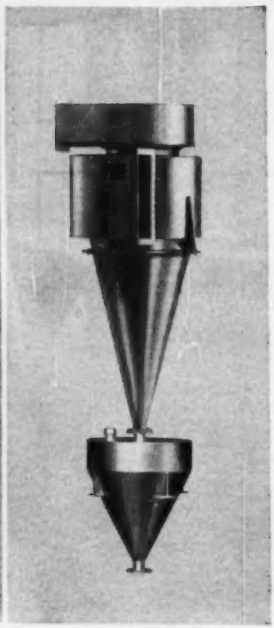

American Blower Type D high velocity centrifugal collectors are built in two series. The Series 321 is recommended for the difficult jobs when a high percentage of the dust particles carried by the gases have a low terminal velocity. The Series 311, with a lower velocity center vortex and increased inlet velocity, is designed for limited space conditions.

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DUST COLLECTORS

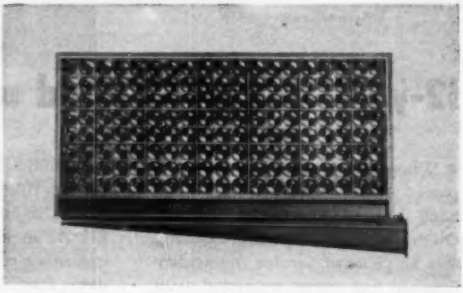
Since 1881, American Blower has specialized in the development, design and manufacture of all types of air and gas handling equipment.

American Blower design and research engineers, utilizing modern research and laboratory methods, have carried on a continuous study of the growing needs of industry for dust collecting equipment.

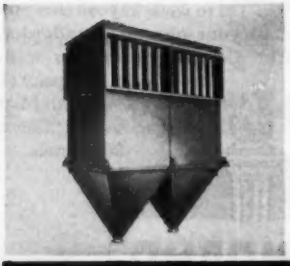
As a result, American Blower pioneered the high velocity mechanical collector now widely used in industry as a means of eliminating a dust nuisance and recovering valuable materials from air.

Shown here are representative types of American Blower dust collecting equipment. For concise, factual data, write for an American Blower technical bulletin, or contact our nearest branch office.

Capillary Air Washer, a wetted-surface scrubber for low concentrations of fine dusts. It is one of a series of wetted-surface and spray-type scrubbers built by American Blower for industrial service.



American Blower Type ST Precipitators are designed to provide maximum collection efficiency over the entire operating range. When they are properly installed and operated, their overall collection efficiency will be from 85% to 90%.



The Series 342 Precipitator is a simple, compact, economical, mechanical type dust collector. Laboratory tests and field installations prove this unit to be suitable to the requirements for controlling dust discharge into atmosphere in a large percentage of industrial plants.

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CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

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8-hour job now takes 4 hours

At a western magnesium reduction plant something besides magnesium has just been reduced. The steam at the end of the 1½ mile long steam line wasn't so hot—and neither was the production record of the plant at that location.

Then 26 old-type steam traps were replaced with Yarway Impulse Traps. Now there is only a 18° temperature drop from the boilers to the end of the line. *Most important, the plant 1½ miles from the boilers is now able to do work in 4 hours that previously took 8 hours.*

That's trap eificiency! It's evidence of the fact that Yarways are designed to send the most premium B.T.U.'s at top temperatures into your process or product. *They get equipment hotter, sooner . . . and keep it hot.*

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YARWAY the steam trap

designed with more production in mind

INDUSTRIAL POWER

January, 1952 Vol. 62, No. 1

TEXTILE MILL EXPANDS STEAM GENERATING FACILITIES

Boilerhouse was extended to right of the stack, and a 3000 kva 13,200/4160 v outdoor substation was installed

When growing production increased demand for electrical power and process steam, power plant facilities were improved, a 4160 v power distribution system replaced one of 2400 v, and a 40,000 lb per hr boiler was installed

H. TOBLER, *Plant Engineer, Celanese Corporation of America*

CELANESE CORP. of America proceeded several years ago with an extensive program of expanding its tricot knitting, dyeing and finishing facilities at Hopewell, Va. This necessitated a survey of steam and electric power requirements.

Studies showed that expansion of the textile facilities would require additional steam and electric power, that existing steam generating equipment could be used, and an additional boiler added without erecting a new boiler plant. A 175 ft brick chimney, three 600 hp water-tube boilers, overfeed stokers, coal and ash handling equipment, railroad trestle, auxiliary equipment, and the building were taken into consideration in planning the layout of an enlarged steam generating plant. The old 2400 v power service was found to be inadequate, and a new 4160 v power distribution system was installed.

It was determined that a steam generating unit of 40,000 lb per hr continuous capacity would be sufficient to meet the steam requirements. This unit had to be small enough to fit between the building columns with space for a future boiler of the same capacity. A boiler with a total heating surface of 5600 sq ft had the required specifications and was selected.

The boiler, auxiliary valves, and piping are designed for a working pressure of 300 psi with no superheat, although the required steam pressure for the processes of the plant is 150 psi.

This selection was made in case, at a future date, the company decides to generate its own power. Performance data for the installed steam generator are given in one of the Tables.

Approximately 25 ft of the north side wall of the original building had to be removed and extended to house the tubular air heater and the tubular fly ash collector. The tubular air heater has 2230 sq ft of heating surface. The fuel burning equipment is a spreader stoker having a 9 ft wide by 12 ft long return traveling grate of 99 sq ft effective area. A spreader stoker was selected due to its quick response to swinging loads, firing characteristics, and its ability to burn a variety of coals. The grates are return traveling and continuous ash discharging. The stoker is equipped with overthrowing type feeders having adjustable distributor blades. The coal hoppers have a total capacity of 600 lb. The boiler is equipped with a cinder return and dust collecting system.

Separate induced-draft and forced-draft fans were installed on the new boiler. In addition, a forced-draft fan was installed to supplement the two existing fans on the three old boilers in order to produce more steam at peak demands.

The original coal handling equipment was extended to include the new boiler. The coal is fed from an overhead conveyer which runs the entire length of the boilerhouse into a new catenary type bunker to the stoker hoppers. The ash from the furnace is discharged into a hopper located directly over the existing ash conveyer, which is in the basement, approximately 15 ft below the floor. The conveyer carries the ashes to an outdoor bin which is elevated high enough to permit a truck to drive underneath to receive a load of ashes.

PERFORMANCE DATA — 40,000 LB PER HR STEAM GENERATOR AT HOPEWELL

Operating data:			
Evaporation, lb of steam per hr	20,000	30,000	40,000
Steam pressure, psig	150	150	150
Steam temperature, saturated, F	366	366	366
Feedwater temperature, F	240	240	240
Heat in steam above feedwater temperature, Btu x 1000	19,744	29,616	39,488
Developed boiler horsepower	590	885	1,180
CO_2 in boiler exit gases, per cent	13.1	13.6	13.6
Excess air in boiler exit gases, per cent	40	35	35
Temperature of boiler exit gases, F	450	495	550
CO_2 in air heater exit gases	13.1	13.1	13.1
Temperature of air heater exit gases, F	350*	355	400
Temperature of air entering heater (room temp.), F	80	80	80
Temperature of air leaving heater, F**	205	295	265
Draft loss through boiler and superheater, in. w.g.	0.2	0.4	0.6
Draft loss through air heater, in. w.g.	0.8	1.3	2.0
Draft loss through ducts and dampers, in. w.g.	0.1	0.3	0.5
Furnace draft, in. w.g.	0.1	0.1	0.1
Total static suction at fan, in. w.g.	1.2	2.1	3.2
Air pressure drop through air heater, in. w.g.	1.2	2.0	2.8
Air pressure drop through ducts and dampers, in w.g.	0.1	0.3	0.5
Air pressure under grates, in. w.g.	0.4	0.7	1.3
Total static pressure at fan, in. w.g.	1.7	3.0	4.6
Fuel consumption, lb coal per hr	1,710	2,540	3,450
Air for combustion, lb per hr	25,100	36,000	48,800
Weight of gases leaving heater, lb per hr	26,700	39,400	53,800
Furnace heat release (not including heater recovery) Btu per cu ft per hr	14,100	21,000	28,500
Firing rate, lb of coal per sq ft grate surface per hr	17.3	25.7	34.9
Overall efficiency, complete unit, per cent	83.9	84.7	83.1
Heat balance:			
Dry flue gas loss at boiler exit, per cent	9.74	10.55	11.95
Loss due to hydrogen and fuel moisture at boiler exit, per cent	4.14	4.20	4.29
Loss due to moisture in air at boiler exit, per cent	0.23	0.25	0.29
Loss due to radiation, per cent	1.99	1.30	0.97
Loss due to unburned combustibles, per cent	1.20	1.30	2.00
Unaccounted for losses and leeway, per cent	1.50	1.50	1.50
Total losses, boiler and furnace, per cent	18.8	19.1	21.0
Efficiency of boiler, superheater and furnace, per cent	81.2	80.9	79.0
Heat recovery in air heater, per cent	2.7	3.8	4.1
Efficiency of complete unit, per cent	83.9	84.7	83.1

*Cold air to bypass air heater at low loads to prevent temperature dropping below 350 F.

**90 per cent of air for combustion passes through the air heater.

Design data:

Maximum continuous capacity, 40,000 lb steam per hr.

Furnace width, 9 ft 7⅝ in.; depth, 11 ft 4⅛ in.; volume, 1670 cu ft.

Heating surfaces: Boiler, 3550 sq ft; water-walls, 1100 sq ft; economizer, 950 sq ft; air heater, 2230 sq ft.

Traveling grate spreader stoker: 9 ft x 12 ft, 99 effective sq ft.

Fuel: Bituminous coal; moisture 5 per cent, volatile matter, 24 per cent; fixed carbon, 64 per cent; ash 7 per cent; heating value, as fired, 13,775 Btu per lb. Assumed analysis: sulfur, 0.7 per cent; hydrogen, 4.7 per cent; fusion temperature of ash, 2650 F.

Combustion Control

The original combustion control system was extended to include operation of the new boiler. On the new boiler it controls the draft fan damper, the furnace draft damper, and stroke of the coal pushers to the feeders. On the existing boilers, the speed of the draft fans, the furnace draft dampers, and the stoker are controlled.

The control panel was equipped with two recording meters and a multi-pointer gage to assist engineers to operate the new boiler efficiently. The meters record the steam-flow: air-flow ratio, and the inlet and outlet temperatures of air and gas to the air heater. The gage indicates draft pressures on the forced-draft fan, two zones in the stoker, furnace draft, boiler outlet draft, air heater outlet draft, and dust collector outlet draft.

Pyrothermocouples are installed under the traveling grates and are connected to indicating pyrometers on the control board to measure the temperature of the grates, and to indicate to the operators the condition of the fuel bed. An indicating light, also installed on the control board and connected to the cinder return fan, warns if the fan is not running. This cinder return fan must run continuously in order to prevent the build-up of fly ash over the reinjection nozzles located in the dust chamber in the boiler.

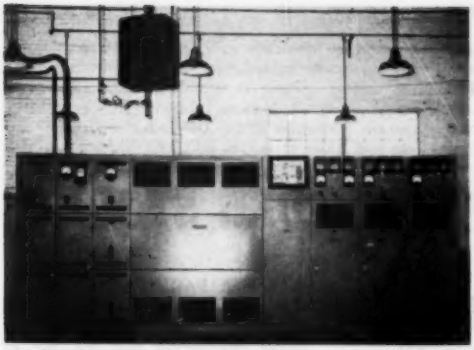
An 8 x 9 in. single-stage double-acting, 100-cfm air compressor was installed to furnish 125 psi air for combustion controls and general boilerhouse service.

Fly Ash Collection

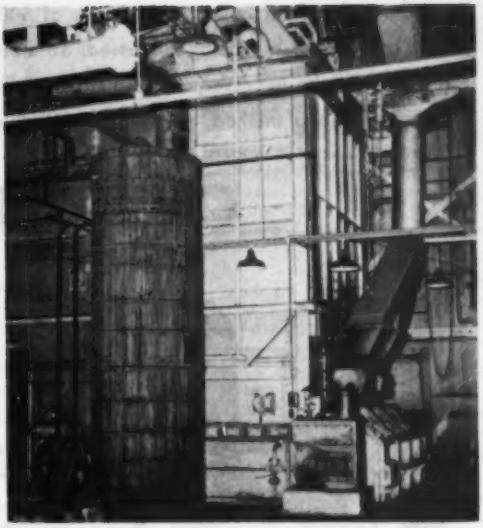
A tubular fly ash collector was installed to eliminate costly repairs to the induced-draft fan and to prevent fly ash from the chimney settling on business and residential areas in Hopewell. The collector consists of three units with dampers on two units which can be cut out during light loads to maintain a uniform velocity of the gas. Fly ash from the collector is removed by a pneumatic ash conveying system, and is discharged into the existing ash bin. The collector has an efficiency of 86.6 per cent at 53,000 lb of gas per hr and at 400 F, based on fly ash analyzing 40 per cent through 325 mesh screen.

Feedwater Treatment

Prior to the installation of the new boiler, only internal feedwater treatment was used. City water, the source of which is the Appomattox River, was used as makeup water and no plant



A 300 kva unit substation and indoor switchgear for boiler equipment were installed in the powerhouse for service on 4160 v and for distributing power to substations in plant



Boiler designed for 300 psi now operates at 150 psi to meet mill's process steam requirements. It will be operated at design pressure when plant begins to generate power

condensate was returned. A softener system of 180 gpm continuous capacity treats the city water. Two-thirds of the water is treated by sodium zeolyte and one-third by hydrogen zeolyte. For final treatment of the water, an automatic intermittent feed unit for the conditioning chemicals is used. The santosite, phosphate and caustic soda are injected into the suction side of the boiler feed pumps.

All of the feedwater is now made up of approximately 50 per cent externally treated water and 50 per cent returned condensate. A heat reclaim condensate unit was installed in the plant to reduce temperature of condensate from traps, thereby eliminating flash in the vented receiver and, at the same time, picking up the greater part of the heat in the condensate returned to the boilerhouse. The old cast-iron feedwater heater was replaced with a deaerating heater of the vertical tray type, which has a heating capacity of 35 to 240 F. Its deareating capacity is 0.03 cc of oxygen per liter. A continuous blowdown connected to all boilers was installed. The heat exchanger was designed for 2600 lb per hr of blowdown reduced from 228 to 60 F, and 75,000 lb per hr of makeup water entering at 50 F.

Power Distribution System

The Virginia Electric & Power Co. installed a new 3000 kva, 13,200/4160 v outdoor main substation adjacent to the boilerhouse. An indoor drawout switchgear unit for service on 4160 v to distribute power to outdoor and indoor unit substations, and including a 300 kva substation with 600 v switchgear for the boiler equipment, was installed in the boilerhouse. A demand meter is mounted on the indoor switchgear. Air breakers for all circuits are electrically operated.

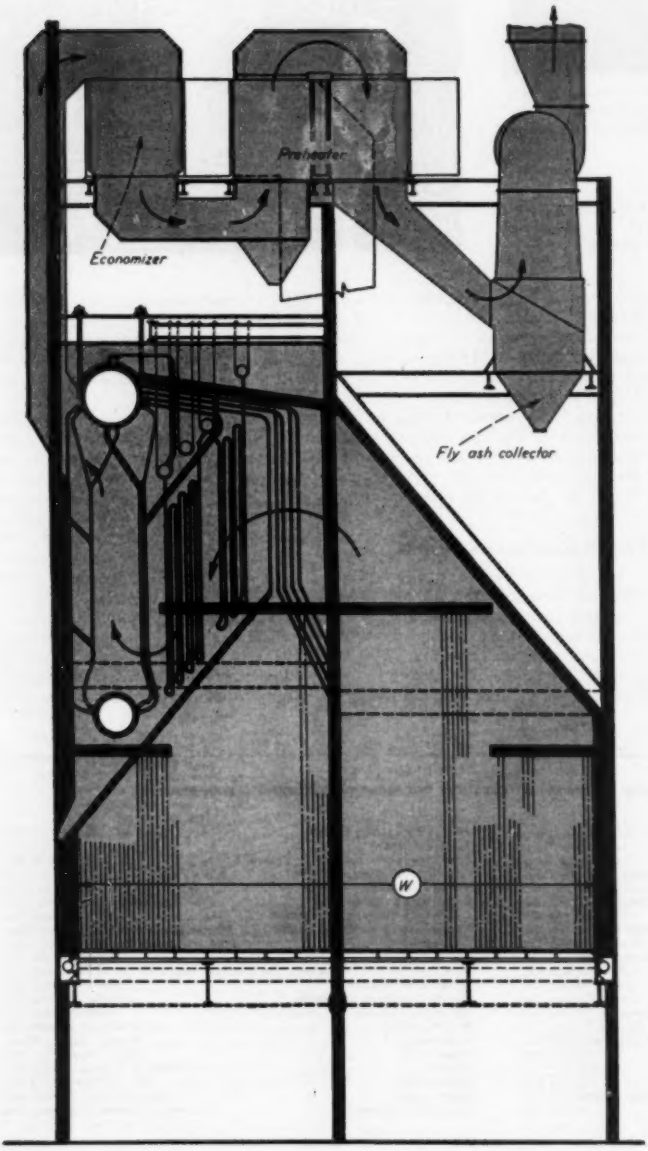
An underground manhole and fiber duct system from the outdoor main substation to the indoor switchgear, and thence to the various substations in the plant area, was installed to eliminate overhead cables. Four outdoor unit substations, consisting of one 1000 kva and three 750 kva, were located in the plant area to supply power at 440 v. Each of the five substations have integrating watthour meters. Lighting power is distributed through 440/120/208 v dry-type lighting transformers located inside the various plant manufacturing buildings.

PRINCIPAL NEW EQUIPMENT AT CELANESE CORPORATION'S HOPEWELL POWERHOUSE

Traveling grate, spreader stoker fired steam generating unit	Riley Stoker Corp.
Fly ash collector	The Thermix Corp.
Fly ash conveying equipment	Hydro-Ash Corp.
Soot blowers	Diamond Power Specialty Corp.
Pyrothermocouples and pyrometers	Pyrometer Instrument Co., Inc.
Coal hopper	Beaumont Birch Co.
Cinder return fan	Clarage Fan Co.
Pressure recording gage	Republic Flow Meters Co.
Blowoff valves	Yarnall-Waring Co.
Gages	Manning, Maxwell & Moore, Inc.
Temperature recorder	The Foxboro Co.
Meters	Bailey Meter Co.
Water column	Reliance Gauge Column Co.
Safety valves	Manning, Maxwell & Moore, Inc.
Feed valves	Edward Valves, Inc.
Feedwater regulator	Northern Equipment Co.
Combustion controls	Hagan Corp.
Atmospheric relief valve	Cochrane Corp.
Boiler non-return valve	Crane Co.
FD and ID fans	Westinghouse Electric Corp., Sturtevant Div.
FD and ID fan turbines	Elliott Co.
FD fan for existing boilers	Clarage Fan Co.
FD fan turbine	Elliott Co.
Boiler feedwater treating equipment	Permutit Co.
Chemical feed pumps	Hagan Corp.
Boiler feed pump	Ingersoll-Rand Co.
Boiler feed pump turbine	The Terry Steam Turbine Co.
Continuous blowdown equipment	Permutit Co.
Vertical closed feedwater heater	Worthington Pump & Machinery Corp.
Condensate unit	Fred H. Schaub Engineering Co., Inc.
Air compressor	Ingersoll-Rand Co.
Pipe covering and insulation	The Standard Insulation Co. of Maryland, Inc.
Boilerhouse extension	Hughes-Foulkrod Co.
Electric manholes and ducts	Hughes-Foulkrod Co.
Boilerhouse piping	Huffman-Wolf Co.
Unit substation	I-T-E Circuit Breaker Co.
Transformers	Wagner Electric Corp.
Power wiring	Harry Alexander, Inc.
Painting	Oliver B. Cannon & Son, Inc.
Steam traps	W. H. Nicholson & Co.
Steam traps	Kaye and MacDonald, Inc.
Consulting engineers	Lockwood Greene Engineers, Inc.

Spreader stoker fired boilers with ratings of 500,000 lb per hr and above are being discussed. To attain such ratings, it may be necessary to fire units at right angles to the conventional method, and adopt designs using . . .

CROSS-FIRED SPREADER STOKERS



IN THE EARLY 1930's, spreader stokers were not taken seriously except for small boilers. Improved application engineering and the use of traveling grates for continuous instead of intermittent ash discharge, late in the 1930's, changed the picture rapidly.

Today, few engineers would have the temerity to install bituminous coal or lignite burning boilers with capacities up to 200,000 lb per hr without giving spreader stokers serious consideration. Actually, boilers of over 300,000 lb per hr capacity fired with spreader stokers are in operation and capacities up to 500,000 lb per hr are being discussed. Data on typical large installations are given in Table 1.

Reasons for their widespread acceptance include (1) simplicity, (2) burn wide range of coals, (3) freedom from clinkers, (4) high burning rates, (5) quick response to load changes, (6) good boiler efficiency, (7) auxiliary power requirements low, and (8) can burn coal, gas or oil in the same furnace.

Because heat releases per unit of area on a spreader stoker are largely independent of the calorific value of the coal, the usual yardstick is Btu per sq ft released per hr per sq ft of active grate area. Thus, for a 600,000 Btu release rate, the burning rate for a 12,000 Btu coal would be a 50 lb per sq ft per hr while the corresponding rate for a 10,000 Btu coal would be 60 lb per sq ft per hr.

Release rates of over 700,000 Btu per sq ft per hr have been found practical for sustained periods and higher rates have been reported. These high burning rates, however, lead to greatly increased carry-over of solids, and in many cases can be avoided.

A fly ash collector is a must on large units. Properly arranged hoppers under boiler passes, economizers, and pre-

Placing the spreader stoker at right angles to conventional method would permit stoker of any desired width W. Increased grate area, and higher fuel burning rates would result, giving higher ratings with narrow boilers

• J. S. Bennett, Vice President of American Engineering Company, herein discusses the trend toward using higher capacity steam generators fired with spreader stokers. Data on typical large units are tabulated, while comments are made not only about 300,000 lb per hr units, but also about ratings up to and higher than 500,000 lb per hr. Fuel burning rates, fly ash problems, and required changes in furnace designs are factors considered.

But of prime interest is the recommendation that spreader stokers for these large boilers be applied at right angles to the conventional method. Ample grate area and high total heat releases in the furnace could be obtained by making stokers as wide as desired. This abstract of a Midwest Power Conference paper reports Europe now has such stokers.

heaters will take out most of the coarse cinders which should be jetted back to the furnace for reburning, but substantial quantities of fine fly ash will be caught in the fly ash collector. Whether the fly ash caught in the collector should be reburned must be decided in each individual case. In moderate duty installations, fly ash return has proved quite satisfactory and provides a convenient method for disposal. The return of fly ash from the collector greatly increases the recirculation of the ash. One excellent solution of this problem, especially for large capacity boilers, is offered by the fly ash collector where the coarse fly ash is trapped separately and can be reburned while the fine ash, usually containing less carbon, can be discarded.

Smoke — Skill of operation, uniformity of fuel spread and overfire air design all influence smoke. In particular, it is important to have an overfire air system, and to use it intelligently.

No hard and fast rule for preheated air temperatures can be made. Perhaps a 300 F limit can be applied with higher temperatures allowed for lignites and high moisture coals and coals with high fusing temperatures of ash. A by-pass for varying the air temperature and to permit use of cold air when desired should be provided. Excessive preheat causes clinkering of the fuel bed, increases ash pit losses, and may overheat the grate bars. There is no advantage in increasing the preheat and then offsetting this gain by increasing the amount of excess air to eliminate clinkering.

While many problems are common to large and small coal burning boilers, certain factors increase in importance with size, justifying extra attention. Among those important in spreader firing are the following:

Rear Furnace Walls — Spongy ash masses may form on rear walls which fall of their own weight on the rear of the moving grate when they become large enough or when the load is reduced. In many plants, this is of little importance and may go almost unnoticed, but on large, heavy-duty load units, these ash masses may interfere with proper burning on the grate. On heavy-duty furnaces, the rear waterwall should have tangential tubes or have metal extensions on the tubes to eliminate major ash adhesions.

Side Furnace Walls—The comments made on rear walls apply but to a somewhat lesser degree.

Front Furnace Walls — Many front walls are entirely of refractory construction or are partly water cooled. Narrow brick piers between closely spaced feeders are hard to maintain. A minimum number of narrow high capacity feeders permit fewer and wider brick piers that are easier to maintain. Perhaps, the ideal construction for severe continuous service is to bring the front water-wall tubes down

TABLE 1—REPRESENTATIVE CAPACITIES AND FIRING DATA FOR LARGE STEAM GENERATORS WITH SPREADER STOKERS

No. of plant and load	Capacity, lb steam per hr	Heat releases — Btu per sq ft per hr	Heat releases — Btu per cu ft per hr	Combustion air temp., F	Type of fuel	Stoker dimensions Length	Stoker dimensions Width	Btu per lb, fuel, as fired	Fly ash from collector	Notes
No. 1 — continuous	160,000	620,000	32,000	Cold	Coal	17' 3"	21' 0"	11,000 - 13,000	Rejected	1
No. 1 — peak	182,000	700,000	36,000	Cold						
No. 2 — continuous	200,000	653,000	22,300	Cold	Coal	18' 2½"	21' 3"	11,500 - 14,000	Rejected	2
No. 2 — peak	230,000	759,000	25,700	350						
No. 3 — continuous	135,000	560,000	24,500	Cold	Lignite	16' 0"	24' 0"	6,800	Rejected	3
No. 3 — peak	150,000	625,000	27,400	340						
No. 4 — continuous	250,000	732,000	21,500	Cold	Coal	18' 8"	27' 7½"	13,000	Rejected	4
No. 4 — peak	300,000	880,000	25,600	Cold						
No. 5 — continuous	135,000	500,000	21,500	265	Coal	19' 3"	17' 0"	11,900	Rejected	5
No. 5 — peak	150,000	557,000	23,000	265						
No. 6 — continuous	180,000	685,000	28,600	Cold	Coal	18' 11"	21' 0"	9,580	Returned	6
No. 6 — peak	200,000	770,000	32,300	Cold						

NOTES:

1. Boiler installed in industrial plant for generation of heating and process steam.

2. Public utility. Stoker designed to handle "dock" coals available. Single pass boiler gives low draft loss and low gas velocities, resulting in effective trapping of heavier cinder particles.

3. Industrial plant in North Dakota burning lignite. Plant has burned natural gas and oil, and combination of two fuels. When burning gas or oil operator stops grate, keeps rotor turning and from time to time feeds a little coal so unit can return to 100 per cent coal burning when desired. Note that a wide short stoker is employed.

4. Unit installed in plant of southern paper company. Can fire bark along with coal. Unit will generate 70,000 lb of steam per hr on bark alone.

5. This central station installation is unusual in that it employs a stoker 19 ft 3 in. long in a furnace only 17 ft wide. It is designed for use with combination oil and gas burners.

6. Spreader stoker replaced firing equipment installed 15 yr ago. During interim period, heating value of coal dropped from 12,300 to 9500 Btu per lb, the latter being used with the spreader stoker.

Stokers built by five different manufacturers are represented in this Table.

between the feeders. Water cooling can then be carried down to within 12 in. of the grate and the water-wall tubes screen most of the bottom part of the front wall. Incidentally, increasing the vertical distance between the grate and the front wall permits a man to enter the furnace at that point and avoids a large side door, improving the design of the side wall. This increased gap results in hotter dutch ovens over the front of the stoker, requiring extra insulation of the dutch oven. Where possible, however, a side door is much more convenient for access to furnace.

High Burning Rates — It has been reported that the average design grate heat release of 32 continuous ash discharge spreader stoker fired plants is 680,000 Btu per sq ft of active grate area per hr. Fifteen plants with capacities under 100,000 lb of steam per hr show an average grate release of approximately 650,000 Btu per sq ft of active grate area per hr, while 17 plants with capacities over 100,000 lb of steam per hr show an average grate release of approximately 715,000 Btu per sq ft of active grate area per hr. The average furnace release for these same plants was 26,000 Btu per cu ft per hr. It must be remembered that these are design figures and that engineers frequently specify higher steaming rates than they actually employ.

Earlier in this article reference was made to the fact that burning rates in excess of 700,000 Btu per sq ft per hr can be maintained. This corresponds to 56 lb per sq ft per hr with 12,500 Btu per lb coal and 100 lb per sq ft per hr with 7000 Btu per lb fuel.

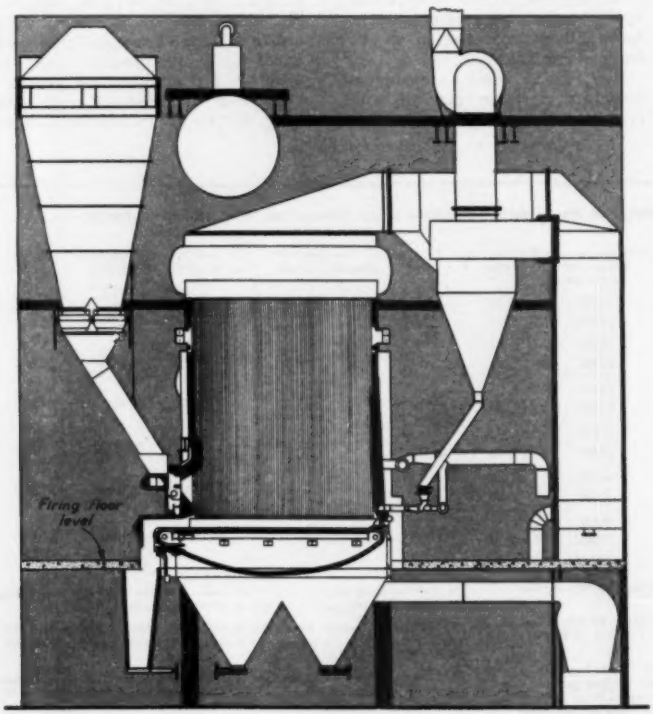
Because spreader stoker boilers have such a strong appeal due to their low first cost, ease of operation, and ability to burn a wide range of coals, the size of spreader stoker fired boilers is bound to increase. Increased boiler width, especially with high steam pressures, is expensive. Stoker lengths are limited by the distance the finer coals can be thrown. Higher and higher burning rates are not the answer because the solids carried out of the furnace increase too rapidly.

Would it not be wise to apply spreader stokers at right angles to the conventional method as shown in Fig. 1? This would permit (1) large steam raising capacity with comparatively narrow boilers, (2) ample grate area by making the stoker width *W* as large as desired, and (3) the maximum use of efficient heat absorbing water-walls with dual furnaces, all without going to excessive stoker lengths. The firing aisle would be at the side of the boiler instead of the front. This has already been done with pulverized coal, oil and gas firing, and would seem to be the next logical step in the development of large spreader fired units.

TABLE 2 — THERMODYNE* BOILER SPECIFICATIONS — CROSS-FIRED SPREADER STOKER

Normal evaporation, lb per hr	28,800
Maximum continuous evaporation, lb per hr	35,200
Steam pressure, psi	440
Superheated steam temperature, F	750
Feedwater temperature, F	150
Boiler heating surface, sq ft	3,034
Superheater heating surface:	
Convection, sq ft	521
Radiant, sq ft	57
Economizer heating surface:	
Wrought-iron tube economizer, sq ft	1,017
Gilled tube economizer, sq ft	8,496
Air-heater heating surface, sq ft	Nil
Effective water-wall area in furnace, sq ft	807
Air temperature to stoker windbox, F	100
Width between sidewalls at stoker level, ft-in.	9-8
Grate length between sprocket centers, ft-in.	15-3
Grate area, sq ft	137

* Thermodyne Engineering Co., Amsterdam, Holland. Boiler built for the Beukema Strawboard and Paper Carton Co., Hoogezand, Holland. Cross-section of this unit, which has continuous-feed cross-firing spreader stoker, is shown in the drawing below.



Cross-firing with spreader stoker was adopted for this Dutch-built 35,200 lb per hr unit. It is reported as first cross-fired spreader stoker installation

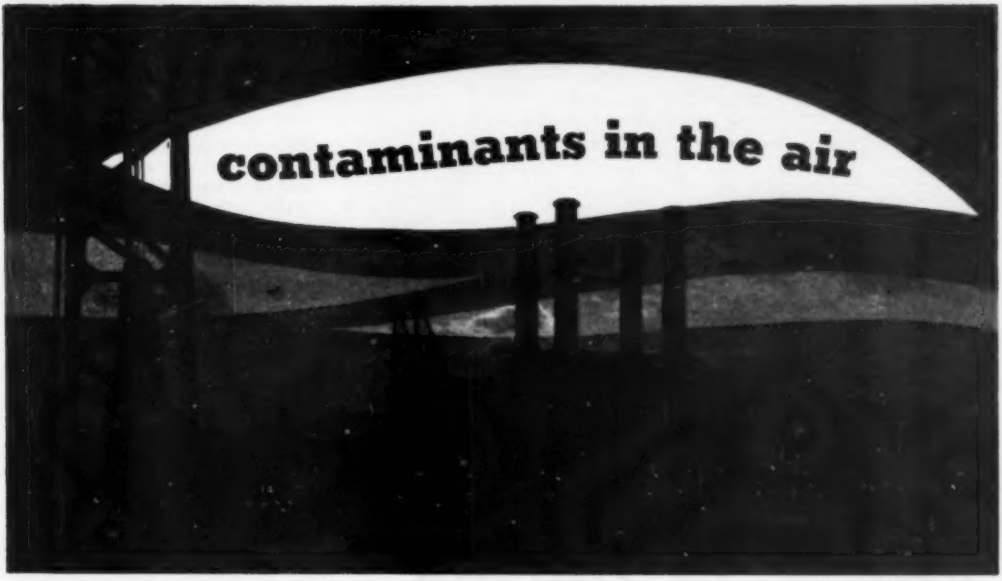
Report from Europe

Comments on cross-firing spreader stokers have been made by W. M. Dodds, managing director of Smith Patterson and Co. Ltd., a machinery manufacturer in the North of England at Blaydon-on-Tyne. This company, among other things, manufactures underfeed and spreader stokers. Mr. Dodds reports:

"The question has been asked if it would be wise to apply spreader stokers in a manner such that boilers would be cross-fired. The answer is undoubtedly 'yes' provided the plant requirements are better satisfied by that method.

"The quantity and composition of

(Continued on page 142)



SPECIAL REPORT TO INDUSTRY

INDUSTRY AND POWER

INDUSTRY has made distinct progress toward eliminating fly ash, soot, dust, fumes and odors that are being discharged into the atmosphere. Societies, such as American Society of Mechanical Engineers, Air Pollution and Smoke Prevention Association of America have entered into the picture along with research organizations, city municipalities and the federal government.

Research developments at Battelle Memorial Institute, Bituminous Research Institute, Mellon Institute and others have gone all out in classifying types of contaminants, developing methods of collecting and recommending steps necessary to alleviate the nuisance at its source.

In addition to these research organizations, manufacturers of collecting equipment have continually placed emphasis on bettering their equipment and finding new and more diversified means of collecting the various contaminants that enter the air. These equipment manufacturing companies have cooperated to the fullest extent with industry in the abatement of air pollution.

In preparing this report the thinking of those organizations was brought together to give the complete picture of what is ahead of industry in its campaign of smoke abatement and reduction of air pollution. Many miles of travel have been consumed in contacting city officials, manufacturers of smoke abatement and air pollution equipment and the actual visiting of plants to obtain data.

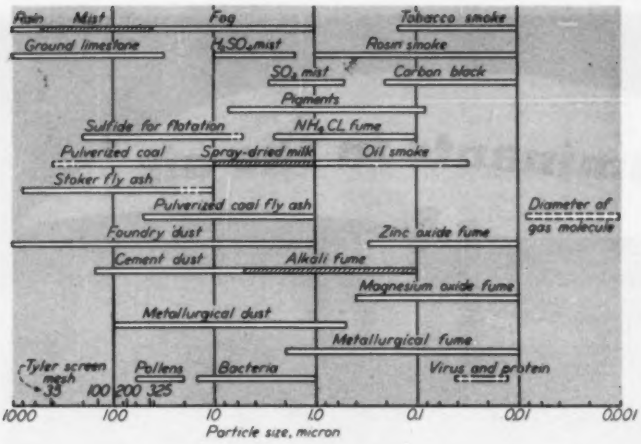
Even though industry has done much to alleviate air pollution, in many areas, better methods must be obtained if progress is to continue. Industry's approach to the problem has been a friendly one, and rare indeed is the instance where management has not gone out of its way to be neighborly by attempting to provide a clean atmosphere. In most cases the problems between industry and neighborhoods have been solved satisfactorily, but in others no amount of money or patience will rectify the situations. Industries hardest hit are those that had plant sites in relatively remote sections only to have the surrounding area become a residential section.

A plant caught in such a predicament, even though management is more than willing to cooperate with the occupants in that particular residential area, must look forward to the problem of practically installing new processing and heating equipment throughout. When the plant was first designed, it is very likely that little attention was paid to smoke abatement or relieving dusts and fumes resulting from processing. At the time of design there was no need for eliminating these contaminants due to the supposed secludedness of the plant site. Reconversion of old equipment is costly, and in most cases management cannot meet the necessary expenditures to eliminate pollution entirely.

This special report contains a description of various types of contaminants that are discharged to the air. Emphasis is placed upon the source of such contaminant and its ultimate effect upon the community. Legal aspects of air pollution and a briefing of the municipal codes will give the Engineered Plant Service group an insight as to what our local and federal governments are now doing and plan to do to help industry cope with this problem.

Modern collecting equipment is presented, and an endeavor is made to aid the engineer in the ultimate selection of the proper unit, regardless of contaminant type.

RALPH A. MOLLER, Associate Editor



Particle size of various contaminants that contribute to air pollution. Two scales for identifying particle sizes are in general usage: the Tyler screen for large particles and micron diameter capable of measuring a gas molecule

SPECIAL REPORT TO INDUSTRY

CONTAMINANTS IN THE AIR

INDUSTRY AND POWER

What they are:

JUST what is air pollution? Obviously, the term refers to foreign matter in the air. But, how much foreign matter and what kinds must the air carry before it is called "polluted" seems to lead to differences of opinion. Heavily contaminated air was once regarded as merely an inconvenience—part of the price to be paid for the benefits of the machine age. Then, nothing short of a dense cloud of noxious fumes would have been described as "air pollution". Dr. Hamnett P. Munger, in charge of air pollution research, Battelle Memorial Institute, sums it up this way:

"The present trend is to define air pollution on the basis of three major effects: injury to property, including crops and other vegetation; injury to health; human comfort and convenience. Using this idea, air pollution can be defined as that concentration of contaminants in the air that is injurious to property, health or comfort. This definition places the emphasis where it belongs—on effects, not on arbitrarily chosen concentrates."

Lester V. Cralley, Industrial Hygienist, Aluminum Company of America, refers to it thus:

"Possibly a good approach is to consider the pollutant a material in the air that renders air unfit for a specific purpose. Air may be considered polluted for many reasons, and pollutants, while detrimental in some instances, may be necessary in others. The mere presence of material in the air does not make it a contaminant.

Only when the concentration is such as to make the air unfit or undesirable for a given purpose may it be considered polluted. For example, a certain amount of water vapor is desirable for health purposes. When a certain range is exceeded, depending upon temperature and air movement, the air may become extremely uncomfortable. Then excess moisture would rightfully be called an air pollutant."

Contaminant Definition

To alleviate any further confusion in the usage of terms, here are the definitions of smoke, dust, fumes, vapors and gases as set forth by the American Standards Association:

Dusts: Solid particles generated by handling, crushing, grinding, rapid impact, detonation and decrepitation of organic materials, such as rock, ore, metal, coal, wood and grain. Dusts do not tend to flocculate except under electrostatic forces. They do not diffuse in air but settle by gravity.

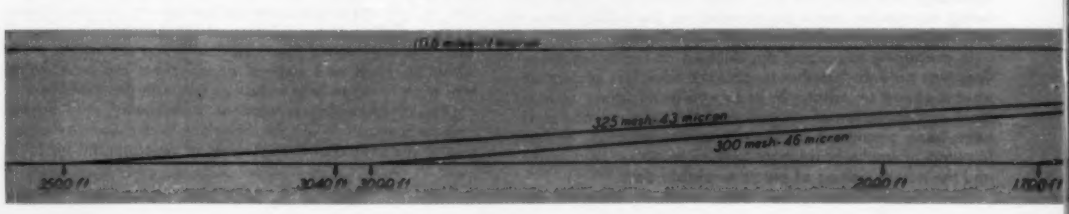
Fumes: Solid particles generated by condensation from the gaseous state, generally after volatilization from molten metals and often accompanied by a chemical reaction such as oxidation: Fumes flocculate and coalesce.

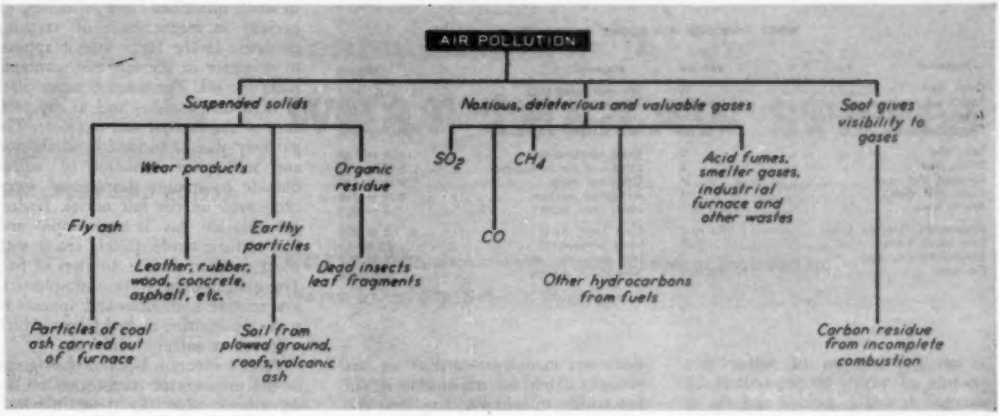
Mists: Suspended liquid droplets generated by condensation from the gaseous to liquid state or by breaking up a liquid into a dispersed state, such as splashing and foaming.

Vapors: Gaseous forms of substances, which are normally in the solid or liquid state and can be changed to these states either by increasing pressure or decreasing temperature.

Gases: Normally formless fluids, which occupy the space of enclosure and can be changed to liquid or solid state only by combined effort of increased pressure and decreased temperature.

The number of air pollutants in any area is almost without limit. However, difficulties arising from industrial air-borne pollution are usually more serious in character than those of nature's making. First, they are more prevalent, physically and chemically





Sources of particles that contaminate air are numerous and no field in industry is exempt — including Mother Nature

more diversified. Second, many of them can be eliminated or abated to a great extent. Some of the major airborne impurities associated with combustion processes are; fly ash from burning of coal, wood and paper; smoke and fumes from refining metals and other materials; and coal dust and cinders (during handling) along with tar vapors carried in flue gases.

Gases Present

Many kinds of gases are present. Those more commonly identified are hydrogen sulfide, chlorine derivatives, carbon disulfide, oxides of nitrogen and sulfur dioxide. Efforts to contain or transform these gases within the various processes of manufacturing are constantly being exerted by plant management through the use of new equipment or operation modifications.

Many of these gases sometimes have intrinsic value at high concentrations. However, even when economic reasons are not present most plants have found it to be good management and good housekeeping to abate gaseous and solid emissions as much as possible to fulfill standards of industrial hygiene and community needs.

Most predominant air bourne solid in affected areas is fly ash from burning coal or other solid fuels, such as wood in furnaces and incinerators. Elimination is not at present economically possible, but recent improvements in design and modern equipment usually enable plants to keep this problem under control.

Another common source of contaminants is from plants using mixtures of fuels such as wood waste and coal. Operating changes and the employment of better designed equipment can often correct most offenders. In some cases steam-air or overfire air jets are practical and are satisfactory.

Discharges from chemical and metallurgical processes, refineries, disposal plants, stockyards and incinerators contribute to the general air pollution of the modern city. Fortunately nature is responsible for dispersion and dilution of pollutants by the winds and thermals, which quickly carry them aloft and to far distances.

Inversions

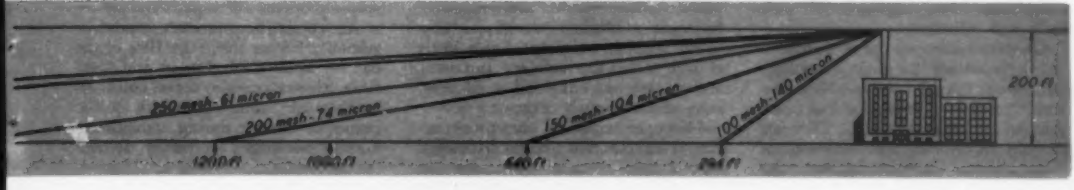
Conversely, light wind may serve to blow these impurities back and forth across the city when meteorological conditions hold gases near the ground and retain them for several days near their source. Such conditions are especially prevalent where topography enters the picture, such as Los Angeles.

Of the chemical compounds contributing to atmospheric pollution, those of sulfur are best known and have been subjected to the most investigation. Undoubtedly the reason for this is the extensive damage done to crops and vegetation during the early part of this century by high concentration of gases from smelter stacks. In many cases, the problem has been brought under control by installation of processes for recovery of sulfur dioxide and the profitable production of sulfuric acid.

Sulfur dioxide in the air is known to contribute extensively to corrosion of buildings and metal objects. It is known to oxidize slowly to sulfur trioxide in the presence of sunlight, and when mixed with water vapor converts to sulfuric acid mist. These fogs will form even though the relative humidity is below saturation, because of their hygroscopic nature.

Chief source of sulfuric dioxide is combustion of fuels, smelting operations, refineries and chemical plants. For example, a large power station burning 5000 ton of coal a day, containing 3 per cent sulfur, will produce

Graphic presentation of Stokes formula illustrates the terminal velocity of particles when being bourne by the wind. Large particles settle out rapidly at source



MOST COMMON AIR BORNE PARTICLES

Material	Microns
Coal dust	10
Powdered coal ash	1 to 150
Tobacco smoke (tar mist)	0.25
Cement dust	5 to 100
Talc dust	10
Silica dust	5
Sprayed zinc dust	15
Flour mill dust	15
Alkali fume	1 to 5
Ammonium chloride fume	0.1 to 1
Zinc oxide fume	0.05
Condensed zinc dust	2
Pigments	0.2 to 5
Sprayed dried milk	0.1 to 3
Iron oxide	0.02 to 0.80
Iron and zinc oxide	0.08 to 1.00
Iron ore and coke dust	0.50 to 20.00
Lead compounds	0.10 to 1.00
Lead and tin compounds	0.10 to 0.80
Chemical fume	0.10 to 1.00
Activated carbon	0.10 to 3.00
Lime (raw stone)	2.0 to 40.0
Lime (raft mud)	1.0 to 25.0
Lead compounds	0.5 to 2.0
Iron ore, coke, etc.	0.5 to 20.0
Ammonium nitrate	Unstable

as much as 300 ton of sulfur compounds, of which 50 per cent is discharged as sulfur dioxide and the remainder retained as metallic sulfur.

Hydrogen sulfide is not often released into the air, because it can be readily burned, except in gob piles, to less offensive sulfur dioxide. Even when present in concentrations below the physiologically damaging point, rapid discoloration of lead paint occurs. It is a constituent of waste gases from pulp mills and is prevalent around sewage disposal plants, gas plants, fires in mines, refuse piles and mine seepages.

Sulfuric acid mist is sometimes discharged from contact acid plants, and the characteristic white plume can be seen for several miles. The aerosol particles never evaporate completely, but reach a size that is dependent upon relative humidity and temperature of the air. In combustion and roasting processes, sulfur is converted to sulfur dioxide, either by thermal decomposition or by reducing action of carbonaceous compounds.

Sulfur Odors

There are several other sulfur products that may exist in the atmosphere as obnoxious contaminants. Elemental sulfur is known to have lacrymatory effects although these are, apparently, not serious at concentration detected in city streets. Severe effects of persulfides of hydrogen, formed by combination of hydrogen sulfide and free sulfur, are reported. Presence of thiophenes and mercaptans, which are among the most readily detected of all chemical compounds because of their extreme odor, is often the cause of complaints from neighbors of pulp mills and refineries.

Oxides of nitrogen are seldom present to the extent that their physiological effects can be noticed. Nevertheless these compounds can contribute through indirect reactions. They are thought to catalyze the oxidation of sulfur dioxide, both in aqueous solutions and in the presence of air and sunlight. They are responsible in part for acidity in rain and fog, thus contributing to atmospheric corrosion.

These oxides are formed in the combustion of some fuels, particularly by oxidation of ammonia. They are present in certain waste gases from refineries, especially those from regeneration of cracking catalysts. Certain chemical plants, such as in the manufacture of sulfuric acid and pickling stainless steel, release small concentrations of gases to the air.

Another nitrogen compound frequently present is ammonia. This also is discharged from refineries and chemical plants and is always detectable around stockyards. Principal effect of ammonia is a neutralizing one. Thus, it offsets the acid condition resulting from oxides of sulfur and nitrogen. It is seldom present in an equivalent amount, and its action is not entirely beneficial, since reactions with acidic gases result in a fine ammonia salt fume or droplets of solution. Thus, there is always a characteristic haze when ammonia salts are released into the air. The gas is soluble in water and since it has a commercial value, the discharge in appreciable quantities is usually prevented.

Fluorine Compounds

Hydrogen fluoride is formed from the volatile silicon tetrafluoride, which is readily hydrolyzed by moisture to yield hydrogen fluoride. Any material that contains calcium fluoride or the mineral fluorapatite, along with sand, will yield silicontetrafluoride when calcined or when treated with acid. Consequently, aluminum and phosphate fertilizer plants are sources of hydrogen fluoride. This gas is now being utilized in the chemical industry as well as in the refinery processes, and its recovery from industrial processes will definitely increase.

Hydrogen chloride sometimes occurs to a slight extent being discharged from certain chemical operations and in small quantities from refineries, especially in regeneration of cracking catalysts. In the latter case it appears to originate in the salt that contaminates the oil. The reaction takes place at high temperatures and in the presence of the catalyst and moisture. The gas may also be formed by absorption and subsequent oxidation of sulfur dioxide by minute droplets of water condensed on the salt nuclei. Hydrogen chloride gas is hygroscopic and like sulfuric oxide quickly reacts with water to form minute droplets of fog. The gas can exist in the atmosphere at low relative humidities and appears to pass through fine matted filters, which will collect sulfuric acid mist.

Proper attention has not been given to the products of combustion of hydrocarbons, especially those in which the oxidation has been incomplete. Into the city air, millions of pounds of carbon dioxide and monoxide are injected each day from combustion of coal, oil, wood and other combustibles. Except for unusual conditions, such as in pockets or directly on the gas stream close to the discharge point, concentrations of neither of these gases ever becomes hazardous.

Physical Properties

When particles are large and consist mostly of water, the system is spoken of as a fog, mist or cloud. If the suspended material should be the result of combustion or destructive distillation, it is commonly called smoke.

Fume is produced by chemical action or by volatilization and condensation. Dust results mainly from natural and mechanical processes of disintegration and dispersion. Smoke or fume particles may be either solid or liquid, and dust consists of solid particles only. Black smoke from combustion of coal represents a small weight but contains a very large number of particles that absorb or reflect light and produce opalescence. Appearance of smoke depends not only on the number of particles in a given volume, but also on their size in relation to the wave length of light.

In many ways the physical properties are more important in atmospheric pollution than the chemical nature of their constituents. They represent an interesting intermediate state of matter, which possesses neither the molecular properties of gases nor microscopic properties of liquids and solids.

All combustion processes produce aerosols of some sort, regardless of the nature of the fuel. Liquid and solid fuels always contain some non-combustible ash, some of which is dispersed to the air during combustion. Fuel is discharged as finally divided ash and smoke.

SPECIAL REPORT TO INDUSTRY

INDUSTRY AND POWER

Contaminants in the air

WHAT THE LAW STATES

MELVIN NORD, *Associate Professor Chemical Engineering,*
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LEGAL ASPECTS of air pollution may be divided, in general, into the two categories of the common law of nuisance and legislative enactments; the latter category including ordinances and statutes. It should not be assumed that the statutes and ordinances have made the common law obsolete, for they provide remedies, which supplement rather than supersede the common law remedies.

"There is perhaps no more impenetrable jungle in the entire law than that which surrounds the word 'nuisance'. It has meant all things to all men and has been applied indiscriminately to everything from an alarming advertisement to a cockroach baked in a pie."[1] By definition, a nuisance is an unreasonable interference with the right of an occupier of land to make such use of it as he pleases. Unfortunately, this "definition" leaves undefined the all-important word "unreasonable". In order for an act to avoid constituting a nuisance it must be "reasonable". But what is reasonable to plant management may be extremely unreasonable to the neighbors. Who is to decide what is unreasonable? In the last analysis it is up to the courts to decide what is reasonable.

This does not imply that we must go to court in every instance to find out whether a particular act constitutes a nuisance. In many cases we are able to predict what the courts will do by a study of what they have said and done in the past. This is the usual approach of the lawyer—regard the decisions in a manner somewhat analogous to experimental data, attempt to correlate the data in the form of general principles and specific rules—then predict what the court will do in the particular case. The process of legal analysis seems to be misunderstood by those outside the legal profession. Most people think that the law is all written down in books and that all the lawyer needs to do is look up the applicable statute in order to know "the law" on a particular subject. Actually there is much more law, which must be deduced from court decisions than is written into the statute books. The "common law" is included in the category of the "case law".

Definition of Nuisance

Nuisances may be classified as public nuisances or private nuisances. A public nuisance is one that affects the public at large, while a private nuisance is one that affects the individual or a limited number of individuals. A particular nuisance may be either or both. The reason why every public nuisance is not necessarily also a private nuisance is that the remedy for the latter has been historically restricted to the occupiers of land. Public nuisances are indictable as minor crimes. In addition, the state may also abate the nuisance or obtain an injunction prohibiting the continuance of the nuisance (which may mean crippling the company or putting it out of business). The remedy for a private nuisance is ordinarily damages. However, where the injury is repeated and is said to cause "irreparable" damage, an injunction will be given.

One of the most common excuses offered for committing a nuisance such as air pollution is that "others are doing the same thing". In principle, of course, this is no justification for wronging another. One nuisance does not excuse another. As a practical matter, however, "the fact that the neighborhood is devoted to offensive uses is to be taken into consideration in determining whether or not any wrong has been done".[2] In such a case, it is quite conceivable that the court will decide that the act was not "unreasonable". Much will depend on the particular factual circumstances.

A common misconception as to the nature of a nuisance is that it must be periodic or continuing in nature. As a matter of fact, this is not necessary. A single act may constitute a nuisance. However, in such a case, abatement of the nuisance is obviously impossible, and a court will refuse to grant an injunction prohibiting the doing of the same act in the future. For intermittent or periodic acts, an injunction will be granted in a proper case, but for a single act, only damages will be granted.

Another common misconception is that an act cannot be a nuisance unless it is injurious to health. As a matter of fact, if the act should interfere with the comfort of the individual or with his use of his property, it is sufficient to constitute a nuisance. An act may be a nuisance because it gives offense to the senses although it does not affect health or the value of property. But a thing is not necessarily a nuisance merely because it is unsightly or offends the aesthetic senses. There must be some physical discomfort. Mental discomfort, such as fear or apprehension that something may happen in the future, is insufficient.[4] To amount to a nuisance there must be such a tangible injury as renders the enjoyment of the property essentially uncomfortable or inconvenient. It is not enough that the act complained of has the effect of diminishing the value of plaintiff's property, or increases the rate of insurance. However, if the existence of a nuisance is once proved, reduction in market or rental value is a proper element of damages.[5]

Existence of a nuisance requires some substantial interference with the interest involved. The law does not concern itself with trifles, or seek to remedy all the petty annoyances and disturbances of everyday life in a civilized community. The injury must be such that it would affect a normal person. Those of too fastidious taste, or hypersensitive individuals, may not complain if they are annoyed by things which would not bother normal people. On the other hand, just because there are some people who are hardened to the discomfort will not prevent a normal person from bringing an action based on nuisance.

The question, of what happens if a business that has been operating for some time in a rural area gradually becomes surrounded by a residential district, presents a difficult and important problem. The general rule in such cases is that the business must give way to the right of the public.[6] This is not to say that it must leave the air in a "country pure" state, for individuals moving into the vicinity of a factory must expect some smoke, etc. What will not be permitted, however, is excessive, i.e. "unreasonable", amounts of pollutants. The company cannot obtain a "priority" to commit a nuisance. If a nuisance exists in such a case, there is no doubt that damages can be awarded. As to the granting of an injunction in such a case, the courts of different jurisdictions decide this question differently.

Property Owners Rights

The question thus raised is one aspect of a more general problem, i. e.: "Will the utility of the business and its value to the community be taken into consideration?" This is undoubtedly the most important question in the law of nuisance as it affects business. It is also one of the most interesting and complex of all the legal problems. [7] The utility of a business will not in itself prevent the business from constituting a nuisance if it would otherwise be one. However, the law does not attempt to impose liability in every case where one person's conduct has some detrimental effect on another. Each defendant is privileged, within reasonable limits, to make use of his own property or to conduct his own affairs at the expense of some harm to his neighbors. He may operate a factory whose noise and smoke cause some discomfort to others, so long as he keeps within reasonable bounds. It is only when his conduct is unreasonable, in the light of its utility and the harm which results, that it becomes a nuisance. As was said in an ancient case in regard to candle-making in a town, "Le utility del chose excusera le noisomeness del stink." This doctrine has been applied to some extent in public nuisance cases, where it is the public that is supposed to have been injured. However, it is not of much use in private nuisance cases, since the "benefit" claimed is to the public and not specifically to the individual plaintiff.[8] Even in public nuisance cases the doctrine is generally limited in usefulness, since practically any substantial injury will be considered unreasonable. The principal application of the doctrine is where an injunction is sought. In such a case, many courts are reluctant to grant the injunction if the business is of importance to the public, but damages will be granted.

In such cases the judge is faced with the question whether the granting of an injunction would not be more harmful than the condition which it is sought to enjoin. On the one hand there is the viewpoint that where an injunction will cause serious injury to the owner of a lawful business or the community at large and relatively small benefit to the complainant, it is only fair that the injunction be denied, and that the plaintiff's remedy be limited to monetary compensation for any damages he may have suffered. This is called the "comparative injury doctrine". On the other hand, there is the more technical viewpoint, which is well expressed in the following quotations: "If the existence of a private right and the violation of it are clear, it is no defense to show that a party has gone to great expense in preparing to violate the right."[9] "It is in effect saying to the wrongdoers 'if your financial interests are large enough, so that to stop you will cause great loss, you are at liberty to invade the rights of your smaller and less fortunate neighbors' ". [10] In view of the fact that the defendant does not seek to avoid liability in these cases, but seeks to recompense the plaintiff monetarily for his damages, this viewpoint seems very harsh indeed. The difficulty, however, is that land is regarded at law as being so unique that a serious impairment of its use and enjoyment is regarded as incompensable in money. The "sacredness" of the right to the use and enjoyment of one's land is illustrated by the following quotations: "There can be no balancing of conveniences when such balancing involves the preservation of an established right, though possessed by a peasant only to a cottage as his home."[11] To permit the—company to continue its operations, even to the extent of destroying the property of the—plaintiffs and requiring payment of the full value thereof, would be in effect, allowing the seizure of private property for a use other than a public one, something unheard of and totally unauthorized in the law. [12] To the argument that serious inconvenience may be caused the public if an injunction is granted, the reply is given that if the public wants to destroy private property on the ground of public convenience, it must exercise its right of eminent domain and compensate the owner therefore. [13] The fact that the plaintiff will be compensated in damages by the defendant is likely to be overlooked.

It is very disappointing to find that the comparative injury doctrine is completely rejected by the courts in the majority of the states, and that it is applied with great caution in the minority of states that recognize it. Although a particular judge may be sympathetic to the idea of refusing to grant an injunction in a hard case, it may be difficult to find a sound legal basis upon which to rest such a decision. In states, which have clearly refused to recognize the comparative injury doctrine, the judge is sometimes driven to hold that the actions of the defendant have not been "unreasonable" in view of all the circumstances. Unfortunately, this makes it impossible even to grant damages, since the court finds that no nuisance exists. Occasionally the judge will find "equities" against the plaintiff, so that he will be left to his recourse at law for damages. An example of this type is when the plaintiff watches the erection of an installation, which is by its very nature a nuisance, without complaining, and then complains after the installation has been completed. In other cases, the judge may find that the damage is "trifling" and not "irreparable", so that an injunction will be denied on the ground that damages are an adequate remedy.

Although the comparative injury doctrine is not generally accepted in full, it is widely accepted when a temporary injunction is sought pending the outcome of litigation in nuisance cases.

Air Pollution as a Nuisance

"Every person has the right to have the air diffused over his premises, whether located in the city or country, in its natural state and free from artificial impurities. However, by air in its natural state and free from artificial impurity is meant pure air consistent with the locality and character of the community. The pollution of air so far as is reasonably necessary to the enjoyment of life and indispensable to the progress of society is not actionable. But this right of pollution must not be exercised in an unreasonable manner so as to inflict injury upon another unnecessarily. Any business, although in itself lawful, which impregnates large volumes of the atmosphere with disagreeable, unwholesome, or offensive matter, may become a nuisance to those occupying adjacent property, in case it is so near, and the atmosphere is contaminated to such an extent, as substantially to impair the comfort and enjoyment of adjacent occupants. Thus, smoke, dust, noxious fumes or gases, or stenches and smells, may constitute a nuisance under some circumstances".[14]

1. Smoke and Soot

Smoke is not a nuisance per se,—but smoke or soot may constitute a nuisance where it injures neighboring property or interferes with its use and enjoyment by persons of ordinary sensibilities.

In McCarty v. Natural Carbonic Gas Co., [15] the defendant company had two smokestacks each 90 ft high, situated 840 ft from the residence of the plaintiff. Defendant used 2½ to 4 ton of soft coal per day and its chimneys continuously poured forth a thick black smoke, large in volume. When the wind was right, the smoke blew down upon plaintiff's house enveloping it and sometimes obscuring it from view. The smoke caused the exterior of plaintiff's house to become discolored with soot, and "caused plaintiff and his family much discomfort and annoyance and some financial injury". The rental value of plaintiff's house had been reduced by $800 up to the date of trial. It was estimated that the use of anthracite coal instead of bituminous coal would cost the defendant an additional $2000 per year. Plaintiff asked for an injunction against the use of soft coal and damages. The court in this case said: "The defendant's business is lawful and not a nuisance in fact.—Some smoke is generally created by the natural and ordinary use of land near a village or city, and, while this may sometimes be annoying to neighbors, it is part of the price paid for living where there are neighbors. But when the smoke is so unusual and excessive as to materially interfere with the ordinary comfort of human existence, the trier of the facts, taking into account all the circumstances, such as public utility, locality, immediate surroundings, and the like, may find the use unreasonable.—It is better—that profits should be somewhat reduced than to compel a householder to abandon his home." It was held that plaintiff was entitled to $800 damages, and that defendant was enjoined from using soft coal, unless he could prove, at a specified date, that he had remedied the smoke nuisance without converting to anthracite coal.

In McClung v. North Bend Coal and Coke Co., [16] the premises of the plaintiff were in close proximity to coke ovens, operated by defendant, that gave forth great volumes of smoke, soot and cinders, causing sickness to the plaintiff and family, injuring shrubbery, filling plaintiff's house with smoke, soot and cinders and greatly injuring its value. The court held that, despite the fact that a large plant would be practically destroyed, plaintiff was entitled to an injunction.

However, where the injury caused by smoke is inconsequential or temporary, injunctive relief will be refused and the injured person will be left to his remedy at law for damages. [17]

2. Dust

Any dust, which substantially interferes with the comfortable enjoyment of adjacent premises, constitutes a nuisance.

In Sullivan v. Jones and Laughlin Steel Co., [18] defendant operated four blast furnaces in a district, which was distinctively and exclusively a manufacturing one. Plaintiff lived on a bluff located about 1000 ft away. The district on top of the bluff was residential. Defendant's stacks were a little higher than the bluff. The blast furnace had recently been rebuilt to a much larger capacity than previously, and were equipped with all modern improvements. They were among the largest known in the iron business, having a capacity of about 500 ton each per day, and consuming together about 500 ton each per day, and consuming together about 4000 ton of iron ore per day. After the fourth and last furnace was blown in, the annoyance and injury began. At this time, defendant had stopped using "Old Range" ore, and began to use "Mesaba" ore. The court found that "Since that time, dust, in greater or less quantities, has been carried from the defendant's furnaces and deposited upon and about plaintiff's premises. The effect of the dust is not only annoying, but injurious to property; it chokes rain conductors upon the houses, discolors fabrics and paints, and injures carpets and curtains; is of a greasy nature, and difficult to remove from both garments and paints; has also been destructive to fruit and shade trees and vegetation generally, and has depreciated the value of plaintiff's property from 25 to 50 per cent. The furnaces were operated in a careful and skillful manner, and no effort or money was spared to keep them in constant good order and repair.—The defendant has been diligent in its efforts to find means, or to adopt appliances or inventions, which will prevent the escape of dust from its furnaces. Up to the present time no appliance has been found that will effectually prevent or reasonably diminish the escape of the ore dust from blast furnaces." Plaintiff asked for an injunction restraining defendant from operating its furnaces in such a manner as to cause the injuries described. The injunction was granted, the court refusing to follow the "comparative injury" doctrine.

3. Fumes and Gases

A most important series of cases concerning the subject of fumes and gases as constituting a nuisance involves two companies operating copper smelters,—the Ducktown Sulphur, Copper and Iron Co., and the Tennessee Copper Co. [19] The first of these cases was Madison v. Ducktown and the Tennessee Copper companies, each being sued by private individuals who asked for an injunction restraining the further operation of the plants. The complaint was that the defendant companies caused large volumes of smoke and fumes to be released that injured trees and crops and rendered the homes of complainants less comfortable and their farm land less profitable than before. The lands were of little agricultural value, each of the plaintiff's lands being assessed at about $80. It was claimed that unless the nuisance was stopped, the land would be unable to support the plaintiffs and they would have to leave. The court found as a fact that the total tax aggregate of Polk county for the year 1903 was $2,585,000, of which the assessments of the defendants amounted to $1,279,000. Prior to the operation of these companies there lived in the district only 200 people, whereas this had been increased to 12,000 people, almost wholly dependant on these copper industries. It was also found that the Tennessee Copper Co. employed 1300 men with an average payroll of $40,000 per month, and that the Tennessee Copper Co. consumed approximately 3000 ton of coke, 2800 ton of coal, and 1000 cord of wood per month. It was also found that 80 per cent of these supplies were purchased from the citizens of Polk County. The court held that the complainants had made out a case of nuisance for which damages could be recovered but refused to grant the injunction because of laches, on the part of one of the plaintiffs—as he had waited ten years before making any complaint. As to the other plaintiffs, the court said: "In order to protect by injunction several small tracts of land, aggregating in value less than $1000, we are asked to destroy other property worth nearly $2,000,000, and wreck two great mining and manufacturing enterprises, that are engaged in work of very great importance, not only to their owners, but to the state, and to the whole country as well, to depopulate a large town, and deprive thousands of working people of their homes and livelihood and scatter them broadcast. The result would be practically a confiscation of defendants property for complainants benefit.

References covering the various court cases in this treatise on "What the Law States" will be found on last page.

Contaminants in the air

WHAT CITY CODES STATE

SPECIAL REPORT TO INDUSTRY

MUNICIPAL SMOKE REGULATIONS first appeared in the United States in the nineteenth century, when St. Louis passed an ordinance, in 1867, that stated "heretofore it shall not be lawful for the owner, proprietor, superintendent, agent or occupant of, or other person using or managing and having control of any steam saw or planing mill, or any factory of any kind, or any foundry or machine shop or any other establishment where steam power is used, to use, continue the use of, maintain any smoke stack or chimney in connection with any such establishment, of less height than 20 ft above the adjoining buildings." Chicago, in 1881, declared the emission of dense smoke within the city to be a public nuisance. Similar measures were adopted in Cleveland, 1892, and in Minneapolis, 1894.

After the turn of the century other cities, facing increased number of industries and widespread use of bituminous fuels, enacted ordinances to curb smoke. By 1912, 25 cities of the 28 having population exceeding 200,000 were making efforts to curb smoke. Municipal regulations are now in effect in the majority of cities over 100,000 population.

No two cities have the same smoke problem. Topography, climate, type and location of industrial activities and condition of fuel burning equipment are very important factors. Hills, wind velocity and thermals affect the rate at which air-borne particles settle to the ground. Relative humidity and barometric conditions may intensify the effects of relatively small amounts of air contaminants. Accordingly, before a proper ordinance can be adopted a thorough investigation of the local problem is necessary. Extent to which each factor influences the total problem, in any area, must be analyzed so control of air pollution may be shaped to fit into the particular local needs and conditions.

Thus, city officials would be ill-advised to adopt in total the ordinance of any other city without first taking care to ascertain if conditions in both are substantially similar. At the same time a knowledge of the ordinance pro-

City	Date	Air contaminants prohibited	Test method	Dense smoke standard	Fuel burning regulations: Installation	Fuel burning regulations: Inspection	Fuel burning regulations: Sales reports	Smokeless fuel control	Boards: Appeal	Boards: Advisory	Rule making authority
Akron	1949	DS FA (8) F	ASME	R3	—	—	—	— —	Yes 9	Yes 9	Yes
Atlanta	1941A	DS FA (2)	—	R3	Yes	Annual	Yes	— —	Yes 3	Yes 13	—
Baltimore	1939	DS FA (6)	TM	R2	Yes	Annual	Yes	User-Sales	Yes 5	Yes 5	Yes
Birmingham	1947	DS	—	R3	Yes	—	—	User —	Yes 5	—	—
Boston	1947	DS FA	—	R3	—	—	—	— —	—	—	—
Buffalo	1947	DS FA F	—	R3	Yes	Annual	Yes	User-Sales	—	—	—
Camden	1948	DS FA F	—	R2	Yes	Annual	Yes	User —	Yes	—	—
Chattanooga	1946	DS FA F	—	R2	Yes	Annual	—	— —	Yes 5	—	—
Chicago	1947	DS FA F	—	R3	Yes	Annual	Yes	User-Sales	Yes 5	—	—
Cincinnati	1947	DS FA (3-7) F	—	U2	Yes	Annual	—	User-Sales	Yes 7	—	Yes
Cleveland	1947	DS FA (5) F	TM	R2	Yes	—	—	User —	Yes	Yes	Yes
Columbus	1949	DS FA (8) F	TM	R2	Yes	Annual	Yes	User-Sales	Yes 5	Yes 5	Yes
Denver	1948	DS FA F	—	R2	Yes	—	—	User —	Yes	—	Yes
Des Moines	1947	DS	—	R3	Yes	—	—	— —	Yes	Yes 9	Yes
Detroit	1947	DS FA (4) F	TM	R2	Yes	Annual	Yes	User-Sales	Yes 5	—	Yes
Duluth	1931	DS F	—	R3	Yes	—	—	— —	Yes 7	—	—
Erie	1948	DS FA F	—	R3	Yes	Annual	—	— —	Yes 3	Yes 9	Yes
Evansville	1949A	DS	—	R2	Yes	—	—	— —	Yes 12	Yes 12	Yes
Fort Wayne	1949	DS FA F	—	R2	Yes	—	—	— —	Yes	Yes 5	Yes
Gary	1917	DS FA	—	None	—	—	—	— —	—	—	—
Grand Rapids	1926	DS FA	—	R3	Yes	—	—	— —	Yes 3	—	—
Harrisburg	1928A	DS	—	R3	Yes	Periodic	—	— —	—	Yes 1	—
Hartford	1937	DS	—	R3	Yes	—	—	— —	—	—	—
Houston	1942	DS	—	—	—	—	—	User —	—	—	—
Indianapolis	1948	DS FA (9) F	TM	R2	Yes	Annual	Yes	User-Sales	AB	Yes 7	Yes
Jacksonville	1945	DS FA	—	None	—	—	—	— —	—	—	—
Jefferson City	1945	DS FA F	—	R2	Yes	Annual	—	— —	Yes 5	Yes 5	Yes
Kansas City	1948	DS FA F	—	R3	Yes	Annual	—	User —	Yes 5	Yes 5	Yes
Lansing	1937	DS	—	U1	—	—	—	— —	—	Yes 3	Yes
Long Beach	1/	DS FA F	—	R2	—	—	—	— —	—	—	—
Los Angeles	1950	DS FA (1) F	—	R2	Yes	Periodic	—	User —	Yes 3	Yes	Yes
Louisville	1949	DS FA F	—	R2	Yes	Annual	—	User-Sales	Yes 7	Yes 7	Yes
Memphis		DS FA F	—	R3	Yes	—	—	User —	—	—	—
Miami	1941	DS FA F	—	R3	Yes	Quarterly	—	— —	—	—	—
Milwaukee	1948	DS FA (8) F	TM	R2	Yes	Annual	Yes	User-Sales	Yes 5	Yes 5	Yes
Minneapolis	1931	DS FA F	—	None	Yes	—	—	User —	—	—	—
Nashville	1947	DS FA (6) F	TM	R2	Yes	Annual	Yes	User-Sales	Yes 3	—	Yes
New Orleans	1934	DS	—	None	Yes	—	—	— —	—	—	—
New York	1/A	DS FA F	—	None	—	—	—	— —	—	—	—
Newark	1938	DS FA F	—	R2	Yes	—	—	User —	Yes 3	—	Yes
Oakland	1/	DS F	—	None	—	—	—	— —	—	—	—
Omaha	1947	DS FA (8) F	ASME	R2	Yes	Annual	Yes	— —	Yes 5	Yes 5	Yes
Peoria	1947	DS FA F	—	R3	Yes	Annual	Yes	— —	Yes 5	Yes	Yes
Philadelphia	1949	DS FA (8) F	TM	R2	Yes	Periodic	—	— —	Yes 7	Yes 7	Yes

visions and formal regulations adopted by other cities of comparable size, and with somewhat similar local conditions, is, of course, desirable and helpful in proclaiming an ordinance, as the basic procedures are similar.

All ordinances or codes have the provision of prohibiting dense smoke. In order to define smoke density in accurate terms, the majority of cities have adopted the Ringelmann scale, available from the United States Bureau of Mines, as the standard of measurement. Shades of smoke or contaminant observed is compared to a chart placed at the proper distance from the eye, so that it appears to have a uniform color. It also provides a means of setting separate standards for different furnaces.

Another standard utilized by some cities is the Umbrascope, which employs clouded glass that has been prepared to cut off a definite amount of light. The observer sights through the instrument to compare the density of the smoke or contaminant with the semi-circular section of colored glass pivoted into the line of sight. Use of the Ringelmann chart has become more widespread than that of the Umbrascope because of speed and ease of operation.

Choice of defined dense smoke as equivalent to or greater than No. 2 or 3 of the Ringelmann scale finds cities about evenly divided. An average of all the cities having codes would define dense smoke as equivalent to approximately 50 per cent blackness. Only 11 of 48 cities have no established standard of definition in their ordinances.

Short Duration Smoking

Recognizing the virtual impossibility of preventing smoke for a short period of time when cleaning the fire boxes or building a new fire, provisions in most ordinances permit emission of dense smoke for periods of short duration. The usual amount is six minutes in a period of one hour. However, the individual variations were found too numerous to warrant tabulation.

Traditional exemptions for private residence from smoke regulations are still retained in several cities, but recent code revisions generally have made requirements applicable to all sources of smoke and pollution.

Regulation of fly ash, fumes and noxious gases is also a matter coming into the scope of smoke control programs. Ordinances of 35 cities contain some prohibitions against fly ash, and 27 cities regulate fumes and noxious gases. Most of these provisions are phrased in broad general terms. Typical is the following excerpt: "No person, association, firm or corporation shall cause or allow the escape from any stack, chimney or open fires into the open air such quantities of soot, cinders, noxious acids, fumes or gases in such place or manner as to cause injury, detriment or nuisance to any person or to the public or to endanger the comfort, health or safety of any such person or to the public or in such manner as to cause or have a tendency to cause injury or damage to business or property."

Specific limitations upon emission of particulate matter are prescribed in 17 cities. Measurement of this material is more difficult than in the case of smoke, due to its invisibility, and requires considerable skill as well as special equipment. Much progress has been made in recent years in defining standards and in developing testing

City	Date	Air contaminants prohibited	Test method	Dense smoke standard	Fuel burning regulations: Installation	Inspection	Sales reports	Smokeless fuel control	Boards: Appeal	Boards: Advisory	Rule making authority
Pittsburgh	1946A	DS FA (6) F	—	R2	Yes	Annual	Yes	User-Sales	Yes 5	—	Yes
Portland	1941A	DS FA	—	R3	—	—	—	User-Sales	Yes 5	—	—
Providence	1947	DS FA F	—	R2	Yes	Annual	Yes	Sales —	Yes 5	Yes 5	Yes
Reading	1948 2/	DS FA IF	—	R2	Yes	Annual	Yes	Sales —	Yes 5	Yes 5	Yes
Richmond	1947	DS FA (11)	TM	R3	Yes	—	Yes	— —	Yes 5	Yes 7	Yes
Rochester	1/	DS	—	Special	—	—	—	— —	—	—	—
Salt Lake City	1941	DS FA F	—	R2	Yes	—	Yes	User —	—	—	—
San Diego	1937	DS FA F	—	R3	—	—	—	— —	—	—	—
San Francisco	1/	DS FA	—	R3	—	—	—	— —	—	—	—
Spokane	3/	DS	—	None	—	—	—	— —	—	—	—
Springfield	3/	DS	—	None	—	—	—	— —	—	—	—
St. Louis	1948	DS FA (6) F	TM	R2	Yes	—	Yes	User-Sales	Yes 5	—	Yes
St. Paul	1925	DS	—	R3	—	—	—	— —	—	Yes 12	—
Syracuse	1948	DS FA (3-8) F	—	R2	Yes	—	Yes	User-Sales	—	—	—
Tacoma	1950	DS FA (7-3) F	—	R2	Yes	—	—	— —	Yes 5	—	—
Tampa	1943	None	—	—	Yes	—	—	— —	—	—	—
Toronto	1949	DS FA (3-8) F	TM	R3	Yes	Periodic	Yes	— —	Yes 7	Yes 7	Yes
Trenton	1/	DS FA	—	None	—	—	—	— —	—	—	—
Utica		DS FA (6)	—	R3	Yes	Periodic	—	— —	—	—	—
Wilmington	1946	DS	—	R3	—	—	—	— —	—	—	—
Yonkers	1950	DS FA F	—	R2	Yes	—	—	— —	—	—	—
Youngstown	1950	DS FA (6) F	TM	R2	Yes	Annual	Yes	User-Sales	Yes 7	Yes 7	Yes

SYMBOL EXPLANATION

Date refers to the year of adoption of the basic code or its most recent revision.

"A" Ordinances now being amended.

1/ Smoke regulations incorporated in city health code, date of which was not furnished.

2/ Proposal ordinance, not yet formally approved.

3/ Smoke regulations incorporated in city fire code, undated.

"DS" refers to dense smoke as measured by the Ringelmann chart or to the "Umbrascope" in which one thickness of 60 per cent opacity glass equals No. 1 scale, two thicknesses equals No. 2 scale, 3 thicknesses No. 3 scale, and 4 thicknesses equals No. 4 scale.

FA (-) Limits of emission of solids vary as follows:

(1) 0.2 per cent SO_2 by volume
0.4 gr per cu ft adjusted to 12 per cent CO_2 at gas temperature except that dust or fumes may not exceed amounts shown in table of ordinance varying from 48/100 per cent of the process weight at 50 lb per hr to 67/1000 per cent of the process weight of 60,000 lb per hr. Maximum permitted 40 lb per hr.

(2) 90 per cent collection entering collector, minimum.

(3) 85 per cent collection entering collector, minimum.

(4) 0.3 gr per cu ft at 500 F and 50 per cent excess air.

(5) 0.425 gr per cu ft at 500 F and 50 per cent excess air. Must collect 75 per cent in equipment installed before ordinance and 95 per cent with new equipment.

(6) 0.75 gr per cu ft at 500 F and 50 per cent excess air of which not more than 2 gr per cu ft shall be larger than 325 mesh, 44 micron.

(7) 0.85 lb per 1,000 lb of gas and 50 per cent excess air.

(8) 0.85 lb per 1,000 lb of gas adjusted to 12 per cent CO_2.

(9) 0.75 gr per cu ft at 500 F and 50 per cent excess air of which not more than 0.2 gr per cu ft shall be larger than 325 mesh.

(10) 0.85 lb per 1,000 of gas containing 50 per cent excess air. Maximum 0.5 lb per 1,000 lb of gas shall be larger than 325 mesh.

(11) 2 lb per 1,000 lb of gases at 12 per cent CO_2 - must collect 75 per cent.

FEES FOR THE INSTALLATION OF BOILERS, FURNACES, AND HOT WATER SUPPLY BOILERS

	Permit	Certificate
Heating boilers, each:		
Less than 1200 sq ft of steam or 1800 sq ft of water	$2.00	$3.00
1200 to 5000 sq ft of steam, 1800 to 7500 sq ft of water	3.00	5.00
5001 to 25000 sq ft of steam	5.00	10.00
Over 25000 sq ft of steam	10.00	15.00
Boilers when installed in each unit of an apartment building, each	0.75	0.75
Hot water supply boilers, each:		
100 to 500 gph capacity	2.00	3.00
Over 500 gph capacity	3.00	5.00
Above based on 100 F temperature rise.		

	Permit	Certificate
Power boilers, each:		
Less than 50 hp	4.00	6.00
51 to 250 hp	5.00	10.00
251 to 500 hp	10.00	15.00
501 to 1000 hp	15.00	25.00
Over 1000 hp	25.00	35.00
Miniature boilers, each	3.00	5.00
Warm air furnaces, each:		
Less than 100,000 Btu output	2.00	3.00
Over 100,000 Btu output	3.00	5.00
Unclassified apparatus	3.00	5.00

procedures. Tentative test code for dust separating apparatus developed by ASME has generally been adopted by cities. Limits are expressed in various terms, such as 0.30 gr per cu ft at 500 F or 0.85 lb per thousand lb of gas reduced to standard conditions.

Smoke Problem

Fundamental principle for reducing smoke is preventing it from entering the air. Once material has been released there is no remedy, and even rain does not change the amount of dirt settling out of the atmosphere. Smoke, the major constituent of polluted air, is the result of incomplete burning of fuels. Under ideal conditions any fuel or combustible material can be burned with almost a complete absence of smoke. The smoke problem boils down to an application of sound combustion engineering principles.

In order to reduce this possible source of pollution, the majority of cities have required approval of all plants for producing heat or power and all chimneys connected with steam plants. Most of these ordinances provide referral by the building department to the smoke agency all plans indicating a stack or chimney of a proposed construction. In some cases such a referral serves merely to notify the smoke agency that the plants contain provisions for fuel-burning equipment. In other cases, codes require the smoke agency's approval of stack and chimney plans as a condition to the issuance of a building permit.

Other ordinances include detailed specification and design standards governing all fuel burning installations included within the scope of the regulation. A more prevalent and generally recommended practice, however, is to set forth the prohibitions and regulations in broad, general terms leaving details to be enumerated in supplementary rules and regulations promulgated by a designated smoke control agency in the various cities.

Annual inspection of fuel burning plants and chimneys is provided for in about half of the cities that require approval of plans for their installations. Number of cities requiring such inspections has increased considerably within recent years.

Another aid to enforcement of installation requirements, that might also be classified as a preventive measure, is the reporting of fuel equipment sales. Distributors of refuse or fuel burning equipment are required to submit reports of such transactions to the smoke enforcement officials in 13 of the cities. One city requires purchasers to report such information.

Volatile Content

Definition of permissible volatile content in a smokeless solid fuel as contained in ordinances varies from a high of 31 to a low of 17 per cent. The maximum limit of volatile content in most cities is 23 per cent, although a few specify 20. Ordinances generally provide for certification of fuel having a higher volatile content than that specified if the smoke inspector determines it meets the same standards in regard to smoke production. The availability of local fuel supplies is frequently an important factor in determining the volatile content to be prescribed.

Sixteen cities make some reference in their codes to the use of smokeless, solid fuels. Providence and Reading merely specify that fuel dealers must leave a bill of sale or certain indication showing whether the fuel is of high or low volatile content. Birmingham prohibits use of high volatile fuel in water heaters unless they are equipped with approved devices. Salt Lake City extends the regulation to all fuel burning equipment designed to burn a solid fuel, except for residential use. Buffalo requires smokeless fuel for residential users only. Minneapolis states "it is unlawful, except in private residences, to burn high volatile fuel in other than smokeless furnaces." Newark authorizes a smoke official to promulgate rules governing the use of equipment varying with the fuels to be burned. Other cities have more drastic regulations; often ordinances are imposed that contain requirements for the use of smokeless fuel.

Penalties

Violations of the prohibition against dense smoke generally are punishable as misdemeanors. Penalties prescribed by the ordinances reviewed vary considerably. In some instances, the first violation was a nominal fine to a maximum fine of $299.00 or six months in jail. For subsequent violations, the usual maximum penalty is $100.00.

Comprehensive codes usually provide that an offender, who has been notified of three or more violations in a year, must appear at a hearing before the smoke abatement administrator to show cause why his equipment should not be sealed. Notification must be delivered by mail to the offender's last known address or by a posted notice on the premises where the violations occur.

Most ordinances make it the responsibility of the enforcing official, following an adverse decision after a hearing, to seal the offending plant until corrective measures are taken to remedy the condition. The same procedures usually are followed in the case of violations of requirements on original or altered installations of equipment, for failure to secure certificates where annual inspection is compulsory or for failure to use a smokeless fuel.

Smoke inspectors, in carrying out the duties of their office, are authorized to enter any premises during reasonable hours and to make inspections and observations. Virtually all of the comprehensive codes make it unlawful to interfere with the activities of inspectors or officials as they perform their inspection duties.

Contaminants in the air

SPECIAL REPORT TO INDUSTRY

DETERMINING SMOKE DENSITY

INDUSTRY AND POWER

SMOKE density can be measured externally by four approximate methods: (1) smoke charts—Ringelmann and variations thereof, (2) instruments that employ smoked, clouded or screened glasses for matching the smoke density, such as the Umbrascope and Density Comparator, (3) screens prepared by photographing parallel black lines on transparent celluloid or glass and (4) photographing the smoke issuing from top of stack.

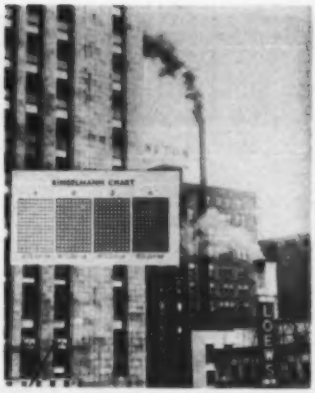
There are several standard smoke charts in use today, the principal difference being the manner in which the solid shades are produced for the comparison. Some utilize different weights of horizontal and vertical black lines (Ringelmann) that give varying shades of gray by which the density of smoke rising from stacks can be determined. This particular type of chart, which measures 24 by 9 in., is hung on a level with the eye, about 50 ft from the observer and as nearly possible in line with the stack. The observer glances at the smoke and notes the chart number corresponding with the shade. A clear stack is recorded as No. O, whereas 100 per cent black smoke is designated as No. 5.

Readings are taken at intervals and recorded, later being reduced to the total equivalent of No. 1 smoke as standard. The sum of the equivalent readings taken, multiplied by 0.20 and divided by the number of readings determines percentage of smoke density.

In order to secure accurate results the light fall upon the chart must be from the same source as that falling on the smoke being observed. Further, observations should be taken from a point at right angle to the direction the wind is blowing the smoke and looking away from the sun when possible. Observation should be made directly across the top of the stack as the smoke emerges for consistent readings.

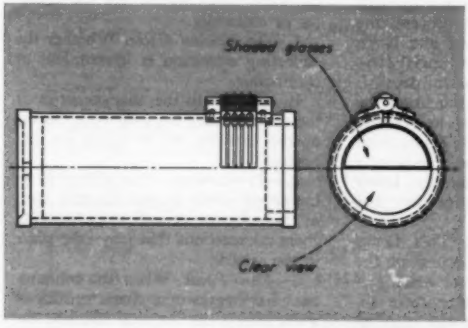
Several instruments are available such as the Umbrascope and smoke Density Comparator. The Umbrascope is a cylinder about four inches long that contains clouded glasses so arranged they can be inserted into one-half the field of vision while the other half of the cylinder is free to observe smoke.

A later development, smoke Density Comparator, contains two cylinders about six inches long. One is fitted with a transparent screen divided into sections of varying shade with a pin hole in the center. The other cylinder is the viewer. By the use of mirrors the screen is projected to the viewing cylinder and, when observing smoke emissions, smoke and screen appear in the viewing cylinder. Light intensity is the same through both cylinders and observation can be made accurately.

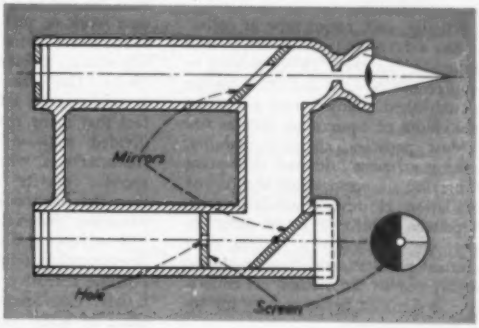


Smoke density is an indication of the amount of fly ash and unburned carbon leaving the stack. Usual allowable, as per city codes, is a No. 3 Ringelmann

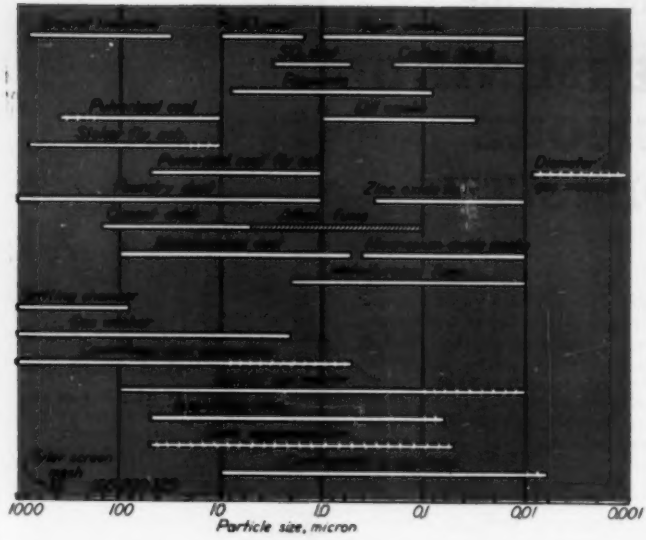
Simple variation of a Ringelmann chart that can aid the observer in determining smoke density. The stack is viewed through the hole, and smoke is compared to shades indicated on the card



Instruments for reading smoke density, such as the Umbrascope, are more accurate than the usual Ringelmann chart



Smoke Comparator, now being developed, has two tubes: one for viewing, the other contains a transparent shade screen



Removal of contaminants before they reach the atmosphere, both inplant and outplant, reduces air pollution and promotes good relations between companies and residents. Equipment for collecting these contaminants have definite characteristics and efficiencies, and the selection of such a unit depends entirely upon the type and size of particulate. Collector characteristics overlap and good judgement is required in the proper selection. Usually the collector manufacturers will aid in determining the best unit for the greatest efficiency. Chart on left indicates the particle size of the most common contaminants and the range of collection for each type of equipment on the market today

Municipalities have placed limits upon the amount of dust emission that will be permitted. Graph, on right, includes limits for old and new equipment along with necessary collector efficiency

SPECIAL REPORT TO INDUSTRY

TOOLS THAT ALLEVIATE POLLUTION

INDUSTRY AND POWER

ONE problem being encountered with increasing frequency by plant engineers is choice of a suitable collecting system for a specific operation. Engineers approaching this situation for the first time, or without considerable experience with air pollution, are apt to feel bewildered by the wide variety of collecting devices on the market, and the many general claims being made as to their efficiency and applicability.

Actually, each major type of collector has a favorite field in which it is applicable, but these fields overlap to a degree and no hard and fast rules can be established. Many factors will affect final choice of equipment, such as size of dust particles, chemical stability, cleaning efficiency desired, dew point of carrying air, temperature and cost of installation. However, there is an overall pattern, which in many cases enables one to classify a specific contaminant problem, and thus be able to roughly predict the method for collecting a designated percentage of the total dust involved.

First step to be considered is the characteristics of the contaminant and carrying gas. This basic information is usually available by the simple expedient of measuring and observing. The following seven facts about the contaminant must be known:

1—*Particle Size.* These data are important because one type of collector may be best suited to remove large particles, while others function more efficiently on smaller sizes.

2—*Apparent Density.* Density affects the rate of flow required through duct work or piping to prevent the contaminant from settling and is an important influence in collector choice. The term "apparent density" is used to take into consideration the fact that many materials—in a finely divided state—exhibit flocculation characteristics, which would indicate a specific gravity considerably lower than the handbook figures for that particular material.

3—*Chemical Stability.* This factor is extremely pertinent because of the possible corrosive effect of many materials. Consequently, presence or absence of water vapor in the carrying gas, as well as the probable construction materials of the collector, must be taken into consideration.

4—*Hygroscopicity.* Materials that possess ability to absorb moisture out of the air usually have a tendency to cake on the walls of duct work, to plug filter fabrics and generally build up back pressure to a point where practically no air is flowing.

5—*Volume.* Amount of material to be collected per unit of time.

6—*Plant Site.* General location of the plant and possible site for collector or collectors.

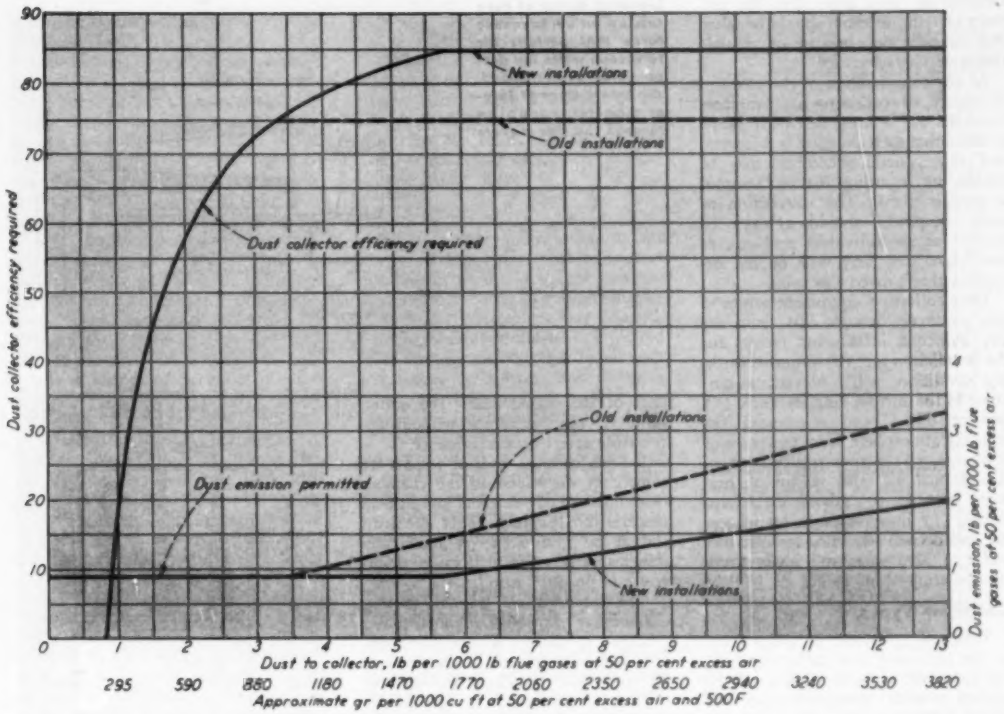
7—*Operational Cycle.* Whether the collecting operation is intermittent or continuous.

In addition to the characteristics of the contaminant, the following factors of the carrying air or gases are important:

1.—*Temperature.* This will have an important effect on the material used in the collector as well as on possible chemical reactions that may take place in the system.

2—*Dew Point.* When the contaminant has hygroscopic characteristics or water affects the chemical stability, the dew point is of great importance.

3—*Other Gases.* Presence of small


New installations
Old installations
Dust collector efficiency required
Dust collector efficiency required
Old installations
Dust emission permitted
New installations
Dust emission, lb per 1000 lb flue gases at 50 per cent excess air
Dust to collector, lb per 1000 lb flue gases at 50 per cent excess air
295 590 880 1180 1470 1770 2060 2350 2650 2940 3240 3530 3820
Approximate gr per 1000 cu ft at 50 per cent excess air and 500 F

APPROXIMATE EQUIPMENT CHARACTERISTICS

Equipment type	Purchase cost, $/cfm	Minimum collectible particle dia microns	Pressure drop through equipment, in. water	Power consumption Kw/1000 cfm	Applications, remarks
A. Gravity settling chamber					
1. Simple	—	40	0.1-0.5	0.1	Simple, large, low pressure drop; precleaner.
2. Howard	—	10	0.1-0.5	0.1	Difficult to clean, warpage problem.
B. Inertial separators					
1. Impingement separators	0.10-0.20	—	—	—	Adaptable to existing flues.
a. Calder-Fox		2	1-5	0.2-1.0	Sulfuric acid mist removal.
b. Miscellaneous		10	0.2-2	0.1-0.5	
2. Cyclone separators		—	1-5	0.2-1.0	Simple, inexpensive, most widely used
a. Single	0.04-0.08	5	—	—	
b. Multiple	0.15-0.50	2	—	—	
3. Mechanical centrifugal separators	0.10-0.30	5	—	0.5-2.0	Compact; ventilation booths.
4. Miscellaneous inertial separators	—	—	1-2	0.2-0.5	May be adaptable to existing flues
C. Packed beds					
1. Fine	2.00-5.00	<1	1-10	0.2-2.0	Removal of radioactive aerosols; sulfuric acid mist removal.
2. Coarse		5	0.2-2	0.1-0.5	Entrainment elimination.
D. Scrubbers		0.5	0.1-50	0.1-10.0	Sludge disposal and corrosion problems
1. Chamber type	0.15-1.50				
2. Cyclone type	0.30-1.00				
3. Inertial type	0.30-1.00				
4. Mechanical type	1.00				
E. Cloth collectors	—	<0.1-	2-6	0.5-1.5	High collection efficiency; temperature and moisture limitations.
1. Baghouse	0.50-2.50				Simple, large.
2. Unit filter	0.15-1.50				For small capacities (<1,000 cfm).
3. Mechanical filter	0.10-0.70				For high capacities.
4. Automatic filter	0.50-2.00				For high dust concentration (<20 gr per cu ft)
F. Electrostatic precipitators		<0.1-			
1. Single-stage	0.30-1.50		0.1-0.5	0.2-0.6	For process gases; heavy duty, expensive on first cost and operation.
2. Two-stage	0.10-0.30		0.1-0.3	0.1	Small, compact; air conditioning applications.
G. Filters			0.1-0.5	0.1	High capacity, low resistance; for low dust concentrations, air conditioning applications
1. Viscous	0.005-0.030	5			
2. Dry	0.005-0.050	2			
3. Automatic	0.05 -0.10				
4. Activated carbon					For odor removal

volumes of gases other than the primary carrying medium should be taken into consideration because of possible corrosive characteristics.

In any consideration of the cost and efficiency of collecting contaminants from the air, it must be clearly borne in mind that each situation is different, and that general statements may be misleading regarding the problems of a specific plant. The installation of such equipment should always be studied as an individual problem, as that plant may very well be the exception that proved the rule.

Dust collecting equipment serves to precipitate or remove dust from the air. Principal influencing factors for the installation are; (a) improve working conditions, (b) prevent a nuisance to the surrounding territory, (c) prevent dust from re-entering the working atmosphere from the point of discharge, (d) permit recirculation of the cleaned air, and saving of heat when possible, (e) salvage usable materials, (f) improve plant housekeeping and decrease building maintenance and (g) save wear and maintenance on operating equipment.

Collector Types

Types of collectors in general use in the industrial dust collecting field are numerous and one or more can be applied to solve a definite problem that exists in the field.

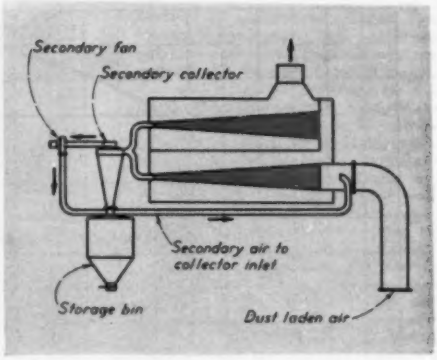
Settling Chamber—The oldest, simplest means of removing dust is accomplished through a reduction in velocity causing dust to drop out of the air stream. This unit is effective only in removing relatively coarse particles, making its application limited. Primary use is a presettling means to reduce the dust loading ahead of more efficient dust collecting equipment.

Pressure drop through a settling chamber is small, consisting entirely of entrance and exit pressure losses. Applications are generally natural draft exhaust from kilns and furnaces due to a low pressure drop and structure simplicity. Usually the collectors are built in the form of a long, empty, horizontal, rectangular chamber with an inlet at one end and an outlet at the opposite end.

Performance depends entirely on horizontal projected area and is independent of height. Height required is only large enough so that the gas velocity in the chamber is not great enough to cause re-entrainment of separated dust. This velocity should not exceed 10 ft per sec.

Another important factor is equal distribution of gas laterally from the entrance of the chamber to the exit. Entrance of gas should be gentle, as a blast of the gas will cause disturbance of the settled dust. The outlet, however, can be abrupt without appreciable effect on performance.

Louvered design of cone sets up an aerodynamic force that permits air to escape while the dust particles are trapped. Air enters through larger diameter, escaping through the side louvers

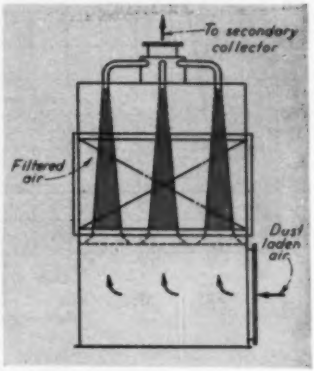


Baffles, curtains, rods or screens are sometimes suspended in the chamber to minimize eddy currents and also to increase collection. This method should be minimized, as too many changes of direction will cause an increase in pressure drop.

One improvement on the settling chambers is to install horizontal plates arranged as shelves within the chamber. This arrangement is known as a Howard dust chamber. Particles as small as 10 micron can be successfully removed. Its chief disadvantage is the difficulty of cleaning due to the close shelf spacing and possible warpage at elevated temperatures.

Baffle Type Collector—essentially a settling chamber fitted with baffles or deflectors, which accomplish dust settling through velocity reduction and centrifugal action created by changes in air direction serving to throw dust into isolated or dead air pockets. The collector is available with baffles or deflectors of varying designs and shapes, so arranged and spaced, as to form a tortuous air pass through the unit. Principal application is for the removal of coarse particles in high temperature problems since the design lends itself to all metal construction. It is frequently provided with an auxiliary water spray compartment to improve over-all recovery.

Centrifugal Collector — commonly known as a cyclone accomplishes dust removal through combined velocity reduction and the action of centrifugal forces. Low pressure cyclone collectors are effective principally on coarser particles. Many designs are available with widely varying external dimensions and proportions and internal adjustment devices. Of more recent designs are the high velocity and multiple cyclone collectors. These units produce a higher degree of separation than the conventional cyclone through the development of higher centrifugal forces with an increase in resistance.



Removal Principle

Dust-laden gas enters a cylindrical or conical chamber tangentially at one or more points and leaves through a central opening. Dust particles, by virtue of their inertia, tend to move toward the outside wall from which they are led into a receiver. A cyclone is, in one sense, a settling chamber in which gravitational acceleration is replaced by centrifugal acceleration. At operating conditions commonly employed, the centrifugal separating force or acceleration may range from five times gravity in very large diameter, low velocity cyclones, to 2500 times gravity in small, high velocity units.

Gas path involves a double vortex, spiraling downward at the outside and upward at the inside. Upon entering the cyclone, the gas velocity undergoes a redistribution so the tangential component increases with decreasing radius. The spiral velocity may reach a value several times the average inlet velocity. At the walls, the velocity approaches zero, reaches a maximum at

a certain radius and decreases rapidly at smaller radii.

Collector efficiency is the percentage by weight of the suspended solid particles removed from the entraining air or gas stream. In order to avoid confusion, this efficiency should be called the over-all efficiency. For any specific design, this over-all efficiency is not a constant quantity, but depends upon certain characteristics of the dust, chiefly, particle size and specific gravity. Efficiency of a cyclone collector will be a constant value for any given particle size and specific gravity, however. This figure, the collection efficiency for a given particle size fraction of the total dust, is called the fractional efficiency of the dust collecter.

Particle Size and Efficiency

Fractional efficiency decreases as the particle size becomes smaller. When the fractional efficiencies of a collector for various material size fractions are plotted as a graph, the curve will show 100 per cent efficiency for very large particles, and approach zero efficiency as the particle size approaches zero micron. Therefore, unless the characteristics of the dust are specifically stated, one cyclone cannot be compared with another on the basis of over-all efficiency. The generally accepted way of comparing collectors is to compare their fractional efficiency curves, which sometimes is misleading.

Cyclones are designed to meet specific pressure drop limitations. For ordinary installations operating at approximately atmospheric pressure, fan limitations generally dictate a maximum allowable pressure drop corresponding to a cyclone inlet velocity. Operation of the cyclone is equally good on the suction or pressure side of a fan if the dust receiver is air-tight. Probably the greatest single cause for poor cyclone performance is leakage of air into the dust outlet. A slight leak at this point can result in a tremendous drop in collection efficiency, particularly with fine dusts.

Air Leakage

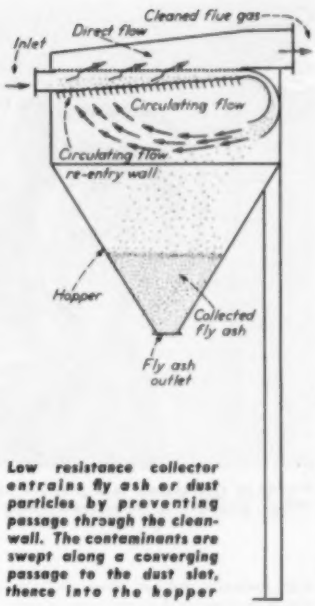
For a cyclone under pressure, air leakage at this point is objectionable, primarily from the local dust nuisance created. For batch operation an air-tight hopper or receiver may be used. For continuous withdrawal of collected dust, a rotary star valve, a double-lock star feeder or a screw belt conveyer with some type of seal may be employed, the latter only with fine dusts.

Identical cyclones in series are not always justified as a certain per cent of the fine will be passed. When the dust particles vary considerably in size the usual procedure is to install a cyclone before a high efficiency collector, such as electrostatic precipitator or cloth filter.

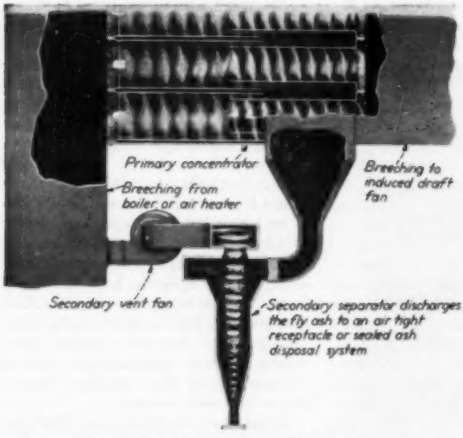
Fan Type Centrifugal Separator—this device is essentially a combined fan and centrifugal collector. It serves as a source of air movement together with a means of removing dust through the centrifugal forces developed by the impeller. Application is principally for the removal of coarser particles. The unit is similar in collecting efficiency to a well designed low velocity centrifugal collector. Impeller scouring results when abrasive dusts are handled, since all material passes through the device.

This type of collector, while similar in appearance to a pressure type blower, is entirely different in principle from any other air handling or dust separating devices. This difference applies both to the housing and impeller, the two components that comprise the unit.

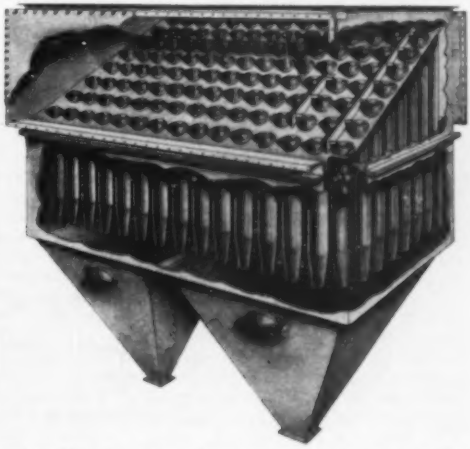
Cast housing, which encloses the impeller provides two air passages—the primary passage through the scroll for the cleaned air and the secondary pas-



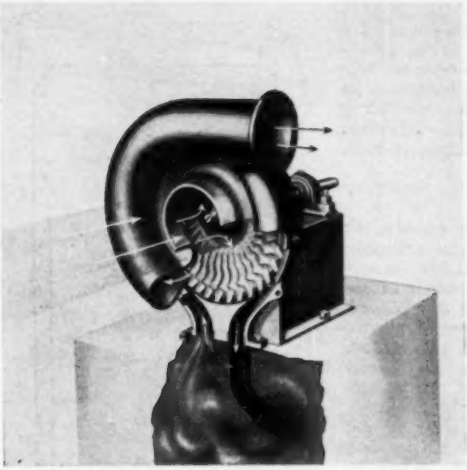
Low resistance collector entrains fly ash or dust particles by preventing passage through the clean-wall. The contaminants are swept along a converging passage to the dust slot, thence into the hopper


Primary concentrator
Breeching from boiler or air heater
Breeching to induced draft fan
Secondary vent fan
Secondary separator discharges the fly ash to an air tight receptacle or sealed ash disposal system

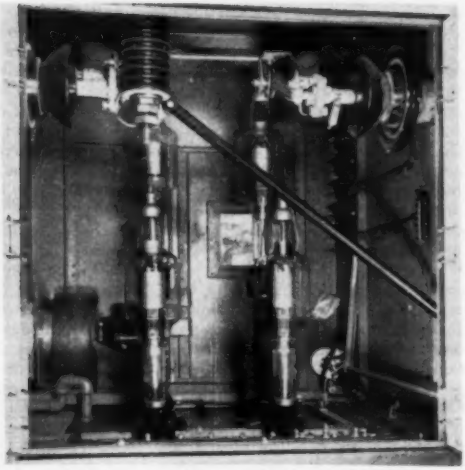
This mechanical fly ash collector, designed for high velocity air, consists of primary and secondary separator systems



Tubular fly ash collector has air entrance in front or top, cleaned air leaves at rear and fly ash descends to hopper



Similar in appearance to a pressure blower, this collector utilises principle of directional change to clean the air



Power pack of electrostatic precipitator converts alternating current to direct current for charging dust particles

sage into the annular dust chamber, which is connected to the dust hopper through cored ports in the base.

The turbine-like impeller consists of hyperboloid blades attached radially to a concave base having a center cone to streamline the air flow. Rotation of this impeller creates the necessary forces to draw in dust-laden air at high velocity and causes it to turn through an arc of almost 90 deg before entering the outlet scroll.

Heavier dust particles are impinged upon the impeller disc while the lighter particles are intercepted by the advancing blade surface. Both light and heavy particles move outward by centrifugal force and converge at a point on the impeller outer edge. Paths of lighter particles, regardless of their location on the blades, intercept this point as a result of the hyperboloid blade contour.

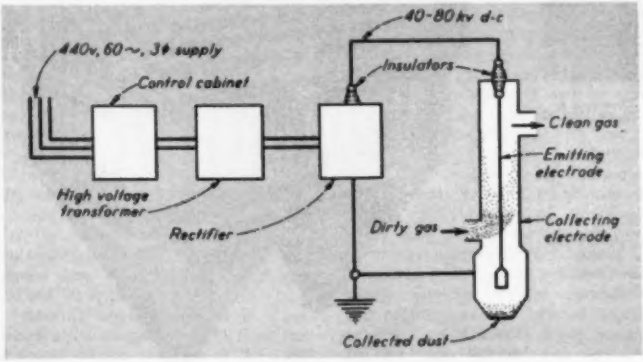
Directly opposite this point of concentration is a narrow annular opening through which dust is projected into a surrounding dust chamber. Blade tips extending into the dust chamber create a secondary air circuit, which conveys the collected material through a port in the base housing to the hopper below. An air-tight hopper serves as a settling chamber, and reduced air velocity permits the entrained dust to settle out of the secondary air stream. Air returns to the dust chamber through the return-air port to be recirculated. The secondary air is not "bled" fom the main air stream, as it is in a closed circuit, and the same air is re-used. The unit has the performance characteristics of a forward curve blade fan and operating range of a medium pressure exhauster. Relation of pressure, air volume and horsepower follow the standard laws of fan performance.

Washer Type Collecter—A modification of the air washing principle used in air conditioning work has been adapted to the industrial dust collection field. Dust precipitation is accomplished by the combined action of passing dust-laden air through water sprays and impinging against wetted surfaces. Collected material is discharged as a sludge and flows from the unit into settling tanks.

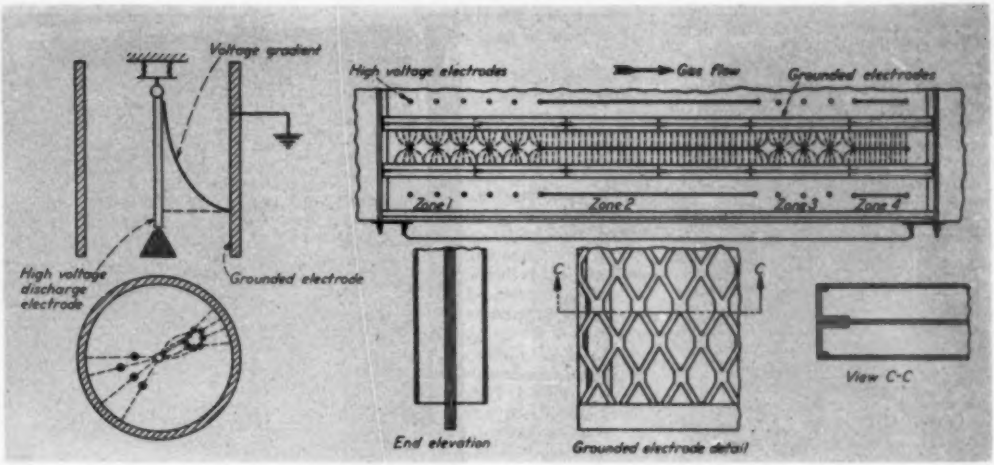
Number of different types of washers available commercially is large and growing rapidly. These units are widely used in industry since they possess inherent advantages for certain cleaning operations. Conversely, they are not best suited for all jobs because they have distinct disadvantages under certain conditions.

Wet methods of removing contaminants from air and gas stream are not of recent origin. Their use for industrial hygiene purposes, such as cleaning air exhausted by process ventilating or local exhaust systems, is more recent than for cleaning process gases. For example, wet collectors of various and sundry sorts for many years have played and are continuing to play a primary role in cleaning blast furnace gas in the steel industry.

Important principles of removal employed singly or in combination in the wet collectors are: (1) collision, (2)



Electrostatic precipitator consists of four basic elements: electrical control cabinet, high voltage transformer, direct current rectifier and the collector



There are two types of electrostatic precipitators: pipe, left, and plate, right. The pipe type consists of a number of cylinders, usually 6 to 8 in. in dia with a fine wire in center. Plate type has parallel plates connected with wire.

electrostatic attraction, (3) moisture condensation, (4) diffusion and (5) impingement. Of these collision is the most important by far in the conventional washer type collector. Diffusion is probably very important when dealing with very fine particles, in the order of 0.5 micron and less.

Moisture condensation, likewise, plays a relatively minor role, and electrostatic attraction probably is not a very important factor. Collectors that make use of the principle of air washing, alone or primarily, include the following: (1) spray chambers or towers, (2) cyclonic spray scrubbers, (3) venturi scrubbers, (4) disintegrators and (5) fog nozzles.

Conventional spray chambers or towers are numerous. Homemade models are common. Water rates frequently used in commercial models range from 5 to 20 gal per thousand cu ft of dirty air. Collecting efficiencies apparently are influenced a great deal by particle size of the pollutant. Thus for dusts, efficiencies by weight of 90 to 99 per cent are not uncommon.

For freshly generated fumes of small particle size much lower collecting efficiencies would be expected. These values vary because of the droplet size, degree of mixing of the air and water and rate of water consumption. Some reports give results as high as 96 to 98 per cent, and there is other information to indicate that it may be as low as 50 to 60 per cent under certain conditions. A range of 50 to 90 per cent probably covers most spray scrubber installations for fumes.

Collectors of this kind alone are sometimes incapable of solving an air pollution problem, but they are useful as primary collectors so as to reduce the dust loading to a point where the gas can be cleaned effectively by means of secondary cleaners.

Cyclone spray scrubbers utilize centrifugal force to carry fine water droplets across the dirty air stream from the axial spray manifold to the scrubber shell. This motion will tend to carry some of the larger particles to the walls of the scrubber. Air rotation in the scrubber is essential to cause the fine water droplets to move across the air stream before the longitudinal motion induced can carry them through the collector.

An unsprayed section in the down stream end of the scrubber is required so water droplets containing particulate matter, swept from the air, have time to move to the collector walls. When scrubber sprays produce large water droplets, they can be projected to the collector walls by kinetic energy imparted by the water pressure. However, large water droplets are not nearly as effective in removing fine contaminants from the air stream.

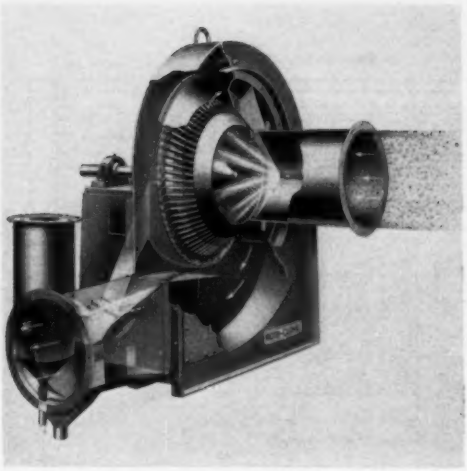
Pressure loss across such collectors is relatively low, being essentially frictional losses plus that required to accelerate the water droplets so the centrifugal force can be effective.

Recently venturi scrubbers have been placed on the market that are designed to obtain good diffusion by removing gas and extremely fine particles. They have been found to be unusually effective against the usual size particulate matter. Velocity of the air to be cleaned is accelerated to about 12,000 to 30,000 fpm in the venturi throat. Dust-laden air strikes solid jets of water, which is introduced at right angles to the air stream either through a collar or by means of internal piping.

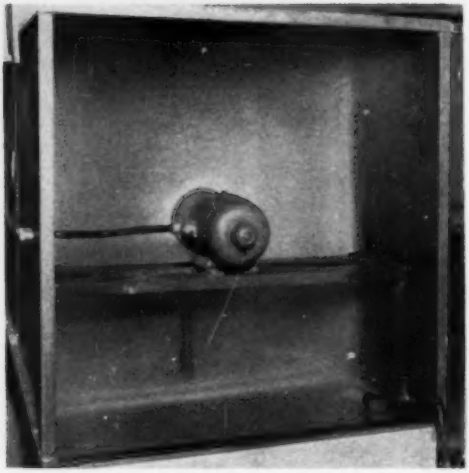
Water pressure is usually 5 to 15 psi, but disintegration is produced by the air velocity. The high velocity serves also to accomplish good air and water mixing increasing the probability of collision between the droplets and particles. Water consumption ranges from 2 to 9 gal per thousand cu ft of gas, 3 to 6 being the common rates. Pressure loss is a function of gas throat velocity and quantity of water consumed and is usually about 15 in. of water, higher pressures are effective on finer particles.

Auxiliary collectors or separators are needed to remove the water droplets from the air stream. Collecting efficiency of this unit is higher than simple spray towers and probably higher than that of any other type of mechanical wet collector. For dusts and particle material of the usual size encountered, good removal is obtained at lower pressure losses, about 8 to 12 in. of water.

Disintegrators have been used for many years in the steel industry for gas cleaning purposes. These units are squirrel-cage fan type devices in which the water is churned violently in one direction, while the dust-laden air passes through the unit in the opposite direction. Disintegrators are true air washers since the cleaning is accomplished primarily by the churn-



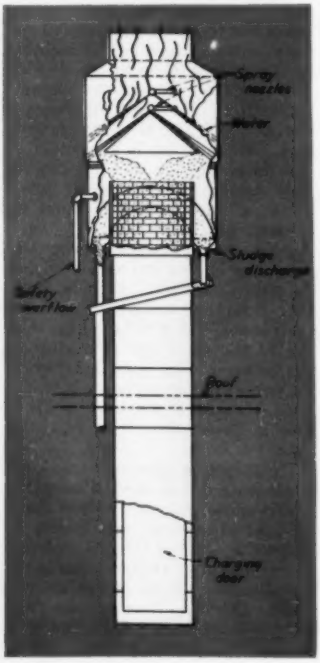
Blower type dust collector has water directed at impeller to wet dust particles that concentrate at blade tip



Spray type washer atomizes water into a fine mist, which acts as a curtain wall to remove particles from the air

ing or scrubbing effect of the water in the air stream.

Fog filters are relatively recent additions to the field of wet collectors. These filters are essentially simple spray washers in which special nozzles and very high water pressures are employed to obtain water disintegration.



Smoke and dust from a cupola must pass through a thick water spray between the core and shell in this type of collector. Water is supplied through specially designed nozzles. The sludge flows to a settling basin and drained

Recommended spray pressure is from 250 to 400 psi.

Sometimes they are housed in a tower or chamber, which forms part of the dust collector installation. Water consumption is about 7½ to 10 gal per thousand cu ft of dirty air. Auxiliary collectors or sprayers may be needed to remove the fine water droplets from the air stream. Pressure loss, as with simple spray washers, is low. The collecting efficiency as in other collectors, is influenced greatly by the type and fineness of the material to be removed. Efficiency values of 70 to 98 per cent have been reported.

Wet Collectors differ from the true washer as they employ combinations of the principles of washing and particle inertia or centrifugal force. Most types employ combinations of washing, sudden directional changes and continuous directional change to capture particulate matter. Air direction may be changed suddenly a number of times in succession to cause the particles near the outer edge of the stream to drift out and be captured by the wetted surface guiding the stream. Water may be tossed about or sprayed so that it continuously passes through the air stream.

Wet Filters are washing towers or chambers in which water is supplied to closely woven screens or filtering materials such as copper filings, hogs hair or vegetable and synthetic fibers. As air passes in close contact with a large wetting area, dust particles drift to the wetted surface of the filtering elements and are captured. Collectors of this type play a much more important role in the removal of gaseous contaminants than of particulate matter.

Deflector Washers are many and varied and operate by (1) causing the dirty air stream to change direction suddenly one or more times, thereby throwing particulate matter out of the air stream against the collecting liquid or wetted surface and (2) churning or spraying the liquid in such fashion that it is thrown through the gas stream one or more times.

Directional changes may be produced by baffles, plates or discs across parts of the air stream at appropriate points. Water dispersion may be accomplished by spraying directly into the air stream, by spraying onto surfaces of contact or by causing the air to churn the water.

Pressure loss across this group of collectors is about 2.5 to 4 in. of water at rated capacity. Collecting efficiencies are influenced by particle size and probably range from 60 to 99 per cent. Water consumption varies from almost nil to about 10 gal per thousand cu ft.

Centrifugal Washers are comparable to deflector washers except that a continuous direction change replaces the sudden direction change of short duration. In fact, any centrifugal fan with a water spray located at the center of the inlet and spraying on the impeller is a centrifugal washer. The rate of

water sprayed must be sufficient to exceed the evaporation rate and to carry collected dust to a hopper or other collecting basin. When spray water is not adequate, some wetted material may adhere to the impeller resulting in unbalance and fan failure.

While water may have a washing effect in some centrifugal washers, it generally serves to retain the particulate matter thrown to the periphery by centrifugal motion and to convey it to the settling basin or point of disposal. Collecting efficiencies and pressure losses are therefore about the same as the comparable dry centrifugal precipitators. Water consumption is unusually low and varies from almost nil to about 4 gal per thousand cu ft.

Electrostatic Precipitator—This is the process of removing suspended particles by the aid of an electrical discharge between electrodes in the air or gas stream. Gases containing suspended particles enter the chamber and pass through the high voltage electrical field pressed across the electrodes. In this field a uni-polar discharge is produced from the discharge electrode, and the gas ions thus formed attach themselves to suspended particles.

Dissipating Charge

These charged particles are attracted to the electrode of opposite polarity, their charge is dissipated and they become electrically inert. Liquid material collected flows down from the collecting electrode, while solid material is removed by special scraping, rapping or washing devices. All materials are deposited into a hopper at the bottom of the chamber, from which they are easily removed for disposal.

Electrostatic precipitators can be utilized under a wide range of conditions. Practically any type of material can be removed, whether solid or liquid, that can be suspended in a gas. Quantity of such material may range from a fraction of a grain to more than 100 grain per cu ft. Depending upon the problem requirements, a removal of up to 99 per cent of the suspended material may be obtained. Gases may be handled at temperatures up to 1200 F and under conditions of either pressure or suction. Velocities through the precipitator are low and pressure drop being nominal, wear and tear from abrasion is negligible. Where corrosive conditions are encountered so that ordinary steel is not suitable, alloys or other corrosion-resistant materials of construction may be employed.

Cloth Type Filter—This type of collector filters dust by flowing the air through specially designed filter fabric. Many variations in design are available but the operation principle remains the same. The cloth type filter is in general use in problems involving the collection of finely divided, dry dust and accomplishes high recovery at economical cost.

Cloth filters consist of a tight casing enclosing the filter fabric so arranged that all incoming air must pass through the fabric to the collector outlet. Upon entering the collector a reduction in velocity occurs serving to drop the coarser particles of material from the air stream. Remaining dust is conveyed to the cloth surfaces where it is filtered, the cleaned air continuing to the outlet. Dust packs or mats thus formed on the cloth surfaces materially assist in improving over-all recovery efficiency. The casing is provided with hoppers into which collected dust is deposited. Filter fabrics are fitted with a shaking device that dislodges the dust pack on cloth surfaces. This shaking operation occurs with air flow shut off since the air pressure tends to hold the dust pack against the fabric.

Designs Available

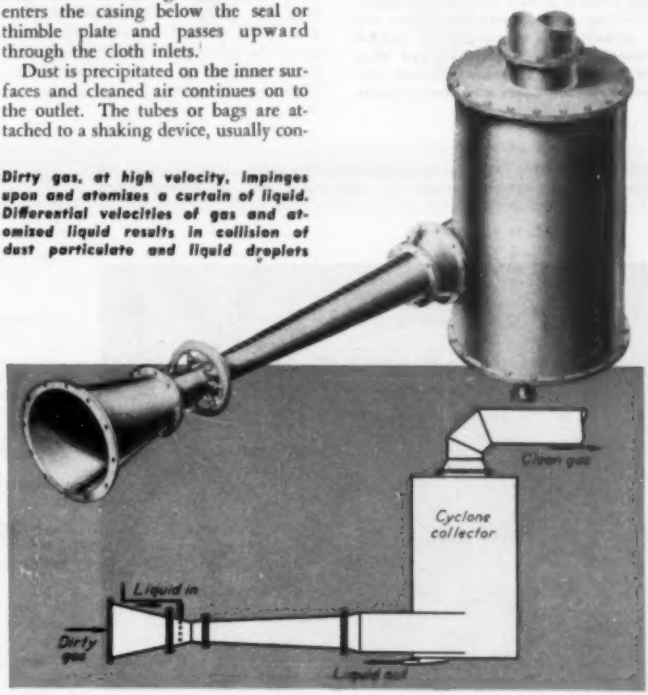
There are two general designs of cloth filters available, the tube or bag and the screen. In the first type the filter fabric takes the form of a series of tubes or bags, open at one end and closed at the other. They are suspended vertically in the casing with the bottom or open end tightly sealed to thimbles in a plate located near the bottom of the casing. Dust-laden air enters the casing below the seal or thimble plate and passes upward through the cloth inlets.

Dust is precipitated on the inner surfaces and cleaned air continues on to the outlet. The tubes or bags are attached to a shaking device, usually connected at the top, that is periodically operated to remove dust pack on the inner surfaces of the fabric. The dust drops to hoppers, located below the unit that form the collector casing.

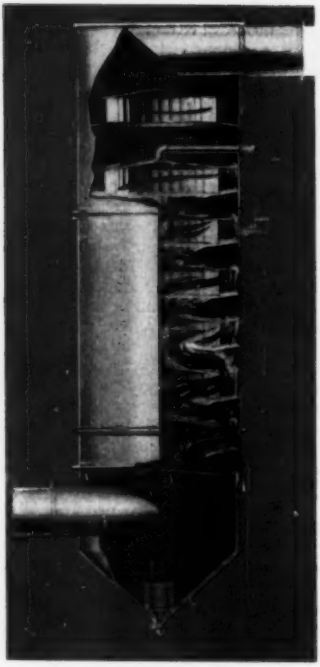
Screen type collectors are a variant of the tube or bag type in which filter fabric is applied over a series of rectangular frames, which effectively support the cloth.

Fabric covers both sides and three edges of the frame. The fourth edge is open and forms a flue for the clean air outlet. Frames are installed side by side in the casing and so arranged that all air flow is through the fabric and out of the open end of the frames. The open ends of the screens are sealed to each other or to the collector casing to divide it into a dirty (dust) side and a clean (clear air) side. Screen frames are connected to a shaking or rapping device for dislodging the dust pack from the cloth surface. Hoppers are provided below the screen into which the collected dust is deposited.

In older designs, frames were of wood construction with fabic stretched over the frames, tacked and glued in place. In more recent designs, frames are of all metal construction with the fabric applied in the form of an easily replaceable bag. Many refinements in design have resulted from extensive



Dirty gas, at high velocity, impinges upon and atomizes a curtain of liquid. Differential velocities of gas and atomized liquid results in collision of dust particulate and liquid droplets



Multi-washer collector consists of a cylindrical tower made in sections. A cone shaped bottom acts as a cyclone, collecting heavier particles from the air stream. The washing agent can be either water or chemicals, and they can be sprayed separately in any section to remove odors and contaminants

operating experience; such as longer life, greater capacity per unit of space occupied, ease of access for inspection, maintenance and repair and more effective cloth cleaning.

Dust Mat

Building up of the dust mat on cloth surfaces results in a gradual increase in collector resistance. This necessitates vibrating the cloth surfaces to reduce the dust pack and resistance to air flow. With the more common collector arrangement, known as the intermittent type, the cloth is cleaned by periodic operation of a shaking device with the exhauster shut down. Frequency and duration of cleaning periods are determined by specific conditions. For average problems with average dust loading, cleaning periods of 5 to 10 min may take place after each 4 to 5 hr. Cleaning periods frequently can, in some instances, be decreased by installing presettling means ahead of the cloth collector to substantially reduce the dust loading handled. Intermittent type collectors are economical in first cost and maintenance for use with operations and processes where short shut downs for cloth cleaning are not detrimental. These cleaning periods are ordinarily arranged to coincide with the lunch hour or shift changes.

Continuous type cloth collectors are used for process applications where shut down periods for cloth cleaning cannot be permitted. This type of collector consists of two or more cloth filter compartments or sections each fitted with an individual shaking device and arranged with gates or dampers to permit alternately isolating each compartment from air flow to permit cloth cleaning. Control of air flow and shaking of the respective compartments may be accomplished in regular cycles through manual operation or by automatically controlled apparatus tied into the system.

These collectors are substantially more expensive from the standpoint of first cost, operation and maintenance. This is particularly true when the installation is of the automatic type, necessitating control and timing equipment needed for shaking.

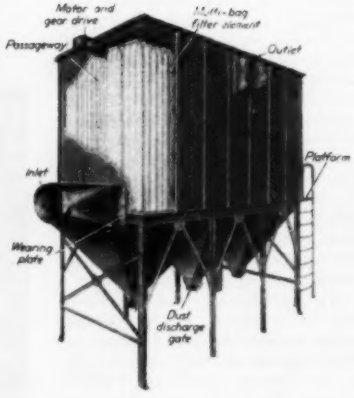
Limitations

Properly applied and maintained cloth filters will provide effective suppression of finely divided, as well as coarse, industrial dusts, but there are several factors, which must be given consideration in their application. Important limiting factors are temperature, moisture and chemical qualities of dust and conveying air or gas. Limiting temperature for cotton filter fabric is approximately 175 F. This limit may be somewhat extended by incorporating wool filter, asbestos fabrics, glass fibercloth and orlon, but at some sacrifice of filtering efficiency.

In most cases when containing moisture, the conveying air and collector temperature must be maintained above the dew point to prevent condensation within the collector. Condensation will result in sludging the dust on the cloth surfaces, greatly increasing the air re-

Shakers are a must for continous operation of a cloth collector. Several types can be installed, such as mechanical and pneumatic units

Dust pack on inner cloth surface acts as an additional filter bed



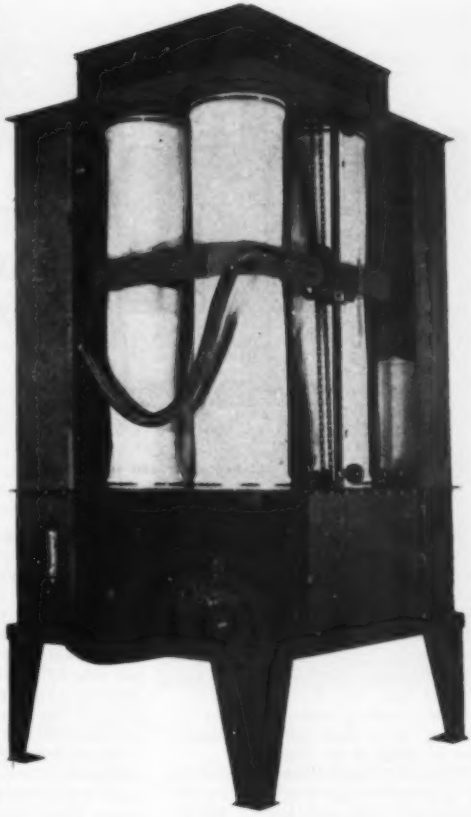
sistance. Chemical properties of the gas or air and materials being handled must be analyzed to determine if a deleterious reaction on the fabric or the collector parts is likely.

Adsorption and Absorption—Gaseous odors are by far the most obnoxious of all the contaminants. Some of the odorous gases are injurious to human health, but others, although objectionable for different reasons, appear to have no physical effect. Two methods of removing these odors and accompanying gases are adsorption and absorption. In the adsorption method vapors and gases containing odors are passed through adsorbents such as activated carbon, silica gel, activated alumina and activated bauxite. These materials attract the vapor or gas molecules and retain them until reactivated.

Absorption occurs when vapor or gas moves completely into the absorbing substance and becomes a homogeneous solution. The absorbing substance is usually a liquid but might be a solid on rare occasions. A good example of this type of chemical would be calcium chloride. Usually the absorbent is in an aqueous solution and regeneration is accomplished by heat.

Adsorption—Activated carbon is generally used to remove obnoxious odors. However, adsorptive capacity varies considerably and depends upon the source of cellulose from which it is derived. Practically all organic vapors are adsorbed to some degree along with such air pollutants as sulfur dioxide and hydrogen sulfide. Consequently, activated carbon is used extensively for solvent recovery and pollution control. In general, silica gel, activated alumina and bauxite are used primarily to remove vapors and have very little value or aptitude for removing organic or chemical compounds.

Absorption— Removing vapors and odors by absorption usually takes place in a tower with liquid absorbent falling through the tower by gravity. Gases to be cleaned are forced up through the tower under pressure. The gas is in contact with the highest concentration of liquid first.

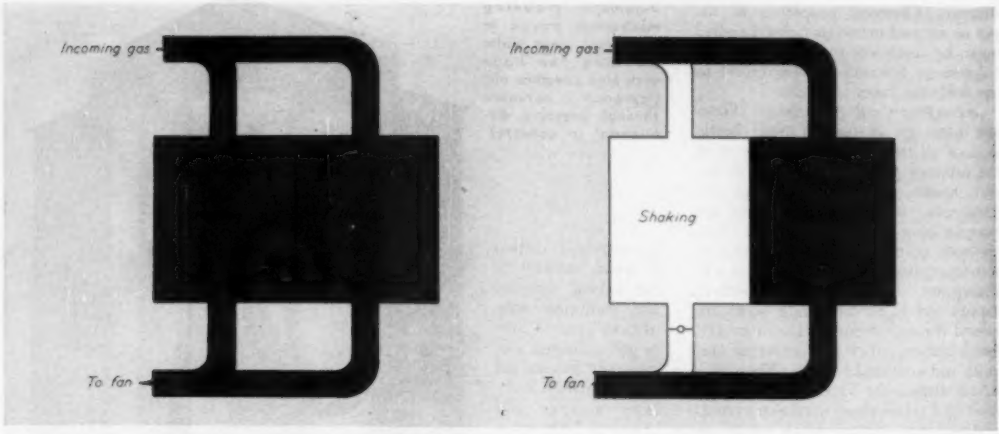


Automatic cleaning mechanism travels in a vertical plane while cleaning the bags with high pressure air. Operation is actuated through pressure differential in collector

PRINCIPAL U. S. MANUFACTURERS AND TYPES OF CLOTH FILTER DUST AND FUME COLLECTORS

Name of Manufacturer	*Address*	*Trade Name of Unit*	*Characteristics**	*Method of Cleaning*
American Wheelabrator and Equipment Company	Mishawaka, Ind.	Dustube Dust Collectors	Vertical cloth dust tubes—Standard Unit Cap.—270 to 47000 cfm	Mechanical shaking at top of dust tubes
Blow-Knox	Pittsburgh, Pa.	Blow-Knox Framed Bag	Framed Bags—collection on outside of bag	Bag frames rapped by beaters vibrated by motor drive
Day Company	Minneapolis, 13, Minn.	Autoclean Dust Filter	Vertical cloth dust tubes with traverse ring. Standard Capacities—664 to 16128 cfm	Reverse air jet operating through traverse ring
Dracco Corporation	Cleveland 5, Ohio	Multibag Filter and Automatic Filters	Vertical cloth dust tubes — Cloth areas 830 to 16000 square feet	Mechanical shaking at top of dust tubes
Northern Blower Company	Cleveland 2, Ohio	Norblo Standard Bag Type and Automatic Bag Type	Vertical dust tubes. Standard—1872 to 33726 cfm. Automatic—2980 to 34560 cfm	Mechanical shaking at top of dust tubes
Pangborn Corporation	Hagerstown, Md.	"CH" Dust Collector	Cloth covered wire mesh screen frame. Collection on outside of bag. 1080 to 29900 square feet	Mechanical rapping of frames with screen beaters
Pulverizing Machinery Company	Summit, New Jersey	The Mikro-Collector	Single vertical felt bag units with traverse ring. Standard sizes 500 cfm up	Reverse air jet operating through traverse ring
Richmond Manufacturing Company	Lockport, New York	Niagara Dust Collector Empire Dust Collector	Cloth tubes arranged in circle to revolve. Max. size 1500 sq ft of cloth	Automatically cleaned by reverse air and rapping
W. W. Sly Manufacturing Company	Cleveland, Ohio	Sly Dust Filter	Cloth bags on screen frame. Dust collects outside of bag. Capacities —1122 to 41888 cfm	Bags rapped mechanically at top
Turner and Haws Engineering Company	W. Roxbury 32, Mass.	Aerotorn	Single and multiple vertical felt bags with traverse ring. All sizes custom built	Reverse air jet operating through traverse ring

*Collection on inside of bag or tube unless otherwise noted.



Parallel operation of cloth bag or screen collectors is utilized when cleaning is not possible during the lunch hour or shift period. One unit can be cleaned with automatic shaking equipment while parallel unit is in service

Another method of creating area of contact, but without serious energy demands, is packing the tower with objects having a large surface. As liquid flows downward the packing surfaces are wetted and a correspondingly large area is presented to the ascending gas. This packing may be interlocked wooden slats, similar to the construction of a cooling tower, or it may be nothing more than coke or crushed rock insoluble in the absorbent.

The ideal liquid to be employed in an absorber is one that will remove vapors and odors satisfactorily, yet be readily regenerated to a higher concentration. Water is satisfactory for many vapors, while others cannot be sufficiently absorbed without large and expensive equipment.

For example, hydrogen sulfide may be absorbed in solutions of sodium carbonate, arsenious oxide and soda ash, sodium phenolate or tripotassium phosphate. Actually, the absorption involves a chemical reaction in which the hydrogen sulfide is transformed into a more agreeable compound.

After the hydrogen sulfide has been removed, the absorbent can be regenerated, and concentrated hydrogen sulfide is liberated. It can then be converted to sulfur or sulfuric acid.

Dilute concentrations of sulfur dioxide in roaster gases may be absorbed in ammonium sulfite solution and later released as 100 per cent sulfur dioxide by treatment with concentrated sulfuric acid. Pure sulfur dioxide may be converted into sulfuric acid or into free sulfur by succeeding treatment.

Comparison of absorption and adsorption as means of removing undesirable vapors from gases is not easy. Adsorption is excellent when large quantities of gas with very low concentrations of vapor are to be handled. Absorption is better when more concentrated vapors are used, since a continuous process is adaptable to such a duty. Adsorption requires filters or other means of removing dust from the gas prior to entering the adsorber, but absorption requires follower devices to guard against entrainment of the liquid absorbent in the leaving gas.

Adsorption reduces the vapor concentration to zero or to traces in many cases, while absorption has appreciably higher limits in most cases. Both adsorption and absorption must be operated at low temperatures.

Catalytic Combustion—Incineration, or oxidation, of fumes is applicable to hydrocarbon gases since the end product is water vapor and carbon dioxide. Sulfurous fumes when oxidized produce sulfur dioxide, which still has a noxious odor, although toxicity in most cases may be lowered.

For many years incineration of burnable solids has been accomplished by gas or oil burner flame. Recently, somewhat similar equipment has been employed in some instances to incinerate hydrocarbon fumes. Effluent gas from industrial processing equipment is passed through a high temperature refractory combustion chamber where sufficient gas heat is added to bring the mixture to oxidation temperature. Temperature, turbulence and oxygen —the essential requirements for complete incineration—are obtainable in this design of flame type fume burners. However, since required temperatures range from 1100 to 1500 F, fuel cost to accomplish flame incineration usually renders this method uneconomical.

Flame incinerators, in order to reduce fuel costs, are operated below the combustion temperature. To offset this necessary high temperature, a catalyst is introduced to accelerate the chemical reaction. Exothermic chemical combination of oxygen and hydrocarbons is accomplished at 500 F.

This catalytic element has the appearance of a metallic air filter mat. The construction is intended to provide a high catalyst surface exposure and turbulence with reasonable minimum resistance to gas flow. Chemical union of oxygen and hydrocarbons occurs without flame on the catalyst medium. Heat generated by incineration is transmitted to the air stream causing an abrupt rise in temperature in direct relation to the potential energy content of the fume-air mixture.

For example, if the mixture entering the catalyst contains energy equivalent to 1 Btu per cu ft at 500 F, the discharge temperature will be raised to slightly over 600 F. With such a low fume concentration there will be no visible evidence of combustion on the catalyst. However, with energy concentration of 5 Btu per cu ft or more—not uncommon in many industrial stack fumes—the resultant temperature rise will cause the catalyst to become a red glow. Sustained discharge temperatures above 1200 F are permissible without damage to the catalyst.

Use of the catalyst is limited to fumes substantially free of unburned solids. While micron size particles will pass through the element, fumes containing large quantities of cinders or abrasives would cause clogging and failure in a short time. Vapors of the metallic group that have a high vapor pressure, such as mercury and zinc will cause poisoning of the catalyst.

SPECIAL REPORT TO INDUSTRY

INDUSTRY AND POWER

FUNDAMENTALS REQUIRED TO REDUCE SMOKE

SMOKE is that product of combustion consisting of very fine particles or molecules of free carbon suspended in a mixture of air and gas. Combustion of coal is not the only source of smoke, for oil and gas are also contributors. Actually, of all the smoke that pollutes the atmosphere about 75 per cent unnecessary and is generally caused by carelessness or improper combustion caused from poorly maintained or obsolete equipment. Primarily, smoke results from the heating of hydrocarbons in an atmosphere that is deficient in the supply of oxygen.

Fundamentals of complete combustion are sometimes summed up in what is known as the three T's: time, temperature and turbulence. Sufficient time for complete combustion must take place before the hot gases contact the heating surfaces in a furnace. This requires adequate furnace volume.

Temperature must be high enough to afford proper combustion of the fuel. In burning bituminous coal this is particularly important even when sufficient oxygen is present. Turbulence is required to insure thorough mixing of the gases with air in order that complete combustion takes place before the hot products leave the furnace. Great importance should be placed upon temperature and oxygen. Deficiency of either will cause improper combustion.

Five steps can be followed to eliminate smoke: (1) burning coal of correct size and classification, (2) supplying sufficient oxygen in a good pattern to the furnace, (3) installing automatic combustion control equipment, (4) installing smoke detection devices and (5) synchronizing detection devices to obtain maximum efficiency from combustion controls.

Knowing coal classifications is the first requisite in selecting fuel for existing or contemplated burning equipment. Coals are analyzed by two methods, proximate and ultimate analysis. Proximate analysis gives information on the behavior of coal when heated. During this process gas and tar vapors, called volatile matter, are driven off. The remainder, fixed carbon, is the solid burnable matter along with moisture and ash content. The relationships of these various materials is represented in percentage of weight.

Ultimate analysis of coal includes the percentage of each element such as carbon, hydrogen, nitrogen, oxygen and sulfur. In either method of analysis it is generally stated whether the sample was as-mined, fuel as-fired or any other particular circumstance under which the coal was tested.

From the standpoint of smoke, volatile matter content is the most important. Unless furnace volume and arrangement of heating surfaces are properly related to the volatile characteristics, burning of the gases and vapors generally forms smoke.

Residue remaining after the volatiles have been driven off is fixed carbon and represents the portion of fuel burned in solid state, either in a fuel bed or in suspension such as in a pulverized fuel furnace.

One other important factor governing selection is the property of coal to cake or its opposite to burn free. Caking coals when heated have a tendency to fuse together into large masses of semicake that prevents air flow through the fuel bed. To obtain sufficient air for combustion, manual or mechanical means must be provided to break up these masses. Thus, coal of this nature is best suited to underfeed type of stokers where mechanical means are available for breaking the cake.

FUEL-BURNING EQUIPMENT SELECTION LIST

Equipment	Anthracite	Bituminous: Caking	Bituminous: Free burning	Sub-bituminous	Coke breeze	Wood refuse
Pulverizer burner	X	X	X	X	—	—
Single-retort stoker	X	X	X	—	—	—
Multiple-retort stoker	—	X	X	—	—	—
Spreader stoker	—	X	X	X	X	X
Chain-grate stoker	—	—	X	X	X	X
Traveling-grate stoker	X	—	X	X	X	X
Stationary grates	X	X	X	X	—	X

RECOMMENDED STANDARD COAL SIZING SPECIFICATIONS

Spreader type stokers:	
Kind of fuel	***Sizing specifications***
Eastern bituminous (friable)	1¼ or 1½ in. nut and slack; not more than 50 per cent slack through ¼ in. round mesh
Eastern bituminous (non-friable) and midwest bituminous	¾ in. nut and slack; not more than 50 per cent slack through ¼ in. round mesh
Underfeed stokers, single or multiple retort:	
Kind of fuel	***Sizing specifications***
Eastern bituminous (friable)	2 in. nut and slack; not more than 50 per cent slack through ¼ in. round mesh
Eastern bituminous (non-friable) and midwest bituminous	1 to 1¼ in. nut and slack; not more than 50 per cent slack through ⅜ in. round mesh
Traveling grate and chain grate stokers:	
Kind of fuel	***Sizing specifications***
Midwest bituminous and lignite	1 in. nut and slack; not more than 50 per cent slack through ¼ in. round mesh (coal uniformly tempered up to 15 per cent total moisture)

Free-burning coal burns as individual pieces, will not fuse together and is ideally suited for spreader and traveling grate stokers. The air flow is practically uniform throughout the fuel bed and agitation of the coal for proper combustion is not necessary.

In Underfeed Stokers, coal is forced by mechanical means into a magazine or retort and is pushed upward into the incandescent fuel bed. Air is forced through the fuel bed by mechanical means. Ash is collected on plates at the side or on dump plates at the rear. Alternate designs have a rear grate mechanism for continuous ash discharge.

These stokers are especially adapted for securing smokeless combustion. Furthermore, these units respond rapidly to changes in load, are easy to bank for a time and handle strong caking coals efficiently. The pushing action of the feeding mechanism breaks up the fuel bed and insures good air distribution.

Chain or Traveling Grate Stokers deposit fuel from suitable hoppers onto a grate that moves slowly inward. Ash is dumped from the grate into a pit at the end of its travel. This method functions well for high-ash, free burning coals. Coals that contain low-fusing ash perform satisfactorily. Ash from the burned portions tend to settle to the bottom of the fuel bed, where combustion is less active.

When burning coals of pronounced caking tendencies, however, it is not unusual to encounter fuel bed conditions conductive to high smoke and dust emission. Such coals tend to form a solid mass of cake, which seriously interferes with uniform air distribution. Air will break through in spots and fuel will burn intensely but unevenly at the rear of the furnace.

Incoming fuel is ignited by heat radiated from an arch, which along with the surrounding furnace construction provides turbulence for the mixing of rich gases at the front of the grate and with lean gases at the rear of furnace.

Since designing a furnace that will be equally efficient in promoting turbulence over a wide range of steam output is difficult, overfire jets are generally installed to provide supplementary mixing of gases. Some chain grate furnaces are constructed with little or no arch construction but rely mainly upon jets to provide the necessary furnace turbulence. Approximately 10 per cent overfire air, at pressures of 10 to 12 in. wg. introduced in the front or rear wall of the furnace is considered good practice.

Spreader Stokers have the ability to handle coals of widely diversified burning characteristics, are easy to operate, respond quickly to increasing or decreasing load changes and have low maintenance even at high burning rates. Operation is with a thin nonagitated bed of burning fuel that rests on a layer of ashes about 2 to 4 in. deep. Fuel is subjected to full furnace temperature before it reaches the grate. As a result, there is a quick partial distillation of volatile matter and tarry hydrocarbons. This characteristic reduces the tendency of caking.

Current designs of spreader stoker fired furnaces generally operate at less than 30,000 Btu per cu ft per hr and many are provided with partial or complete water cooling. Maximum burning rates for traveling grates are generally employed only with generators of over 100,000 lb of steam per hr with large water-cooled furnaces. Such units provide long gas travel between grate and boiler entrance. Motor-driven blowers capable of delivering 5 to 30 per cent overfire air are installed in practically all newer installations. This procedure provides needed furnace turbulence for improving combustion, controlling smoke and reducing cinder carryover.

Although the trend is definitely toward mechanical firing, many smaller boilers are still hand-fired and operator skill is the all-important factor in burning fuel with minimum smoke and cinder carryover. There are three general recognized and accepted methods of good firing; (1) coking, (2) alternate or strip and (3) spreading.

Many existing plants have limited grate area, questionable furnace design and are difficult to operate in compliance with ordinances. Although little can be done to reduce objectionable discharge from some of the installations, others can be substantially improved. Overfire jets provide necessary turbulence to offset furnace volume limitations and reduce smoke.

When the problem is primarly excessive cinder or fly ash, cinder traps or dust collectors could be installed. In a few instances only a simple trap will suffice when the total emission is low and the particles are large. These traps depend upon a combination of direction change and lower velocity to remove coarse material from the gas stream. As the quantity of dust and percentage of fines in the gases increase, a low resistance collector and, in some cases, even high resistance units are required.

Insufficient Grate Area

When grate area is so small that high burning rate is the basic cause of smoke and high dust emission, a study of the possible addition of grate area and furnace modifications is necessary. Incorporating a continuous ash discharge mechanism on some stokers might eliminate fuel bed disturbance, high smoke density and carryover that accompanies grate cleaning.

Another important factor is a continuous, uniform feed of the proper size of coal to all hoppers of the stoker. This feed characteristic is essential to promote fuel bed and furnace conditions for maximum combustion efficiency, low smoke density and dust.

Minimum smoke and fly ash require adjustment of fuel and air-delivery to all sections of the furnace in regard to amount, ratio and furnace draft regulation. Skilled, attentive operators can do this job quite well for a steady boiler output, particularly for firing systems that operate with a relatively thick fuel bed. However, under fluctuating steam demands manual regulation of coal and air supply for maximum efficiency becomes difficult.

This problem is even more difficult when attempted on a firing system with a thin fuel bed and suspension burning. For instance, a spreader stoker has a thin fuel bed, small reserve of energy in the furnace and a sensitivity to variation in feeding rates. Automatic control for such a furnace is the only practical means of operation to assure best stack condition.

UTILIZING OVERFIRE AIR

OVERFIRE jets for the reduction of smoke are not a cure-all, especially in old furnace installations. In new installations many factors enter into the smoking picture such as: improper selection of fuel, poor engineering, over-loading of boiler or inadequate equipment and just poor firing practice. But, as a whole, the addition of these jets will go a long way toward eliminating smoke and meeting even the most rigid city ordinances.

Overfire jets prevent smoke before it forms by forcing air into the furnace to aid in the complete combustion of unburned carbon and gases. If excess air is already present, the jets supply turbulence for proper combustion.

On the large, other benefits can be derived from overfire jets. For example, (1) slag and soot formation on boiler tubes are reduced, (2) final temperatures can be lowered as the boiler surfaces are cleaned and heat transfer is more efficient, (3) volume of excess air can be reduced, thus lowering fan power consumption, (4) boiler and furnace efficiency are increased and (5) carbon content in the cinder carry-over is reduced along with a substantial increase in coal output. However, predicting the benefits of these jets is not always practical as each installation can react differently, depending upon furnace configuration, type of firing, burning rate and coal classification.

Two basic objectives of overfire jets are: (1) introduce turbulence and air close to the fuel bed, where the hydrocarbons are released and (2) provide full coverage and a good pattern over the entire fuel bed. Two methods are available: blower jets and steam-air jets. Steam jets are employed to produce turbulence when sufficient air is available for complete combustion of the gases and additional air would tend to cool the furnace. Although smoking might be confined to a limited portion of the grate, jets should be located so the entire grate area is covered.

Few definite rules can be made in regard to jet location, but recognizing the principles of the combustion type of stoker in question will prove beneficial. Exploration of the firebox can be made with a hose equipped with steam nozzle projected through the available furnace openings. Observing the relative decrease in smokiness above the fuel bed will give an indication in what furnace wall and the approximate elevation above the fuel bed the jet should be placed. Past experiences in the placement of these jets, however, has brought about a definite pattern for each type of furnace, and these designs can be employed to meet any particular installation.

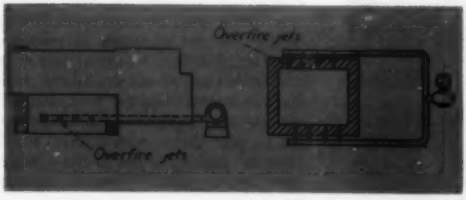
In underfeed stokers, either single or twin retort, distillation of hydrocarbons is largely confined to the area of the fuel entrance. For this reason, jets aimed over the retort area will prove adequate. However, if there is a tendency to overload the unit, jets should be provided to cover the dump plates.

Jet Location

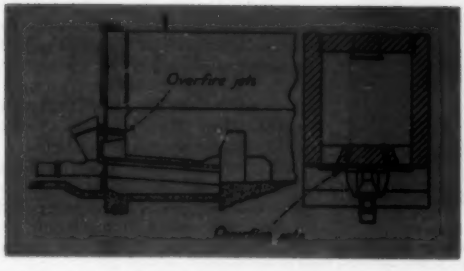
Jets are most effectively located in the front or rear walls of traveling grate stokers. Front installation controls the amount of air to the hydrocarbon under conditions of maximum turbulence, while jets in the rear wall force the lean strata rising from the rear of the grate toward the front to mix with the richer hydrocarbon gases.

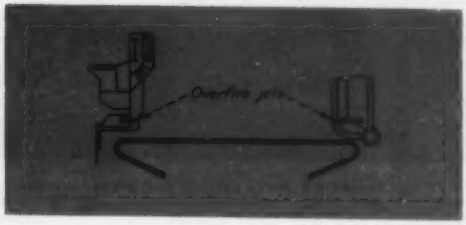
Jets providing turbulence in spreader stoker fired furnaces is generally all that is required to assure low smoke densities. There still remains considerable difference of opinion as to the type and location. This is feasible because of the widely diversified conditions of furnace configuration, burning rates and coal characteristics that influence combustion performance. Rules are established that prove beneficial under most conditions.

With modern furnace configuration jets located about 18 in. above the grate will effectively lower smoke density and provide a low dust loading at the furnace outlet and low carbon loss. In treatment of small furnaces best results have been obtained when the jets are located from 9 to 12 in. above the grate. Positioning of the jets in respect to the front, rear and sides appears to be a matter of preference, as each location seems to be equally satisfactory. This results from the fact that the primary need in spreader stoker fired furnaces is good turbulence and the utilization of the existing air.



Overfire jets, either high pressure air or steam, will provide excess air and turbulence to complete combustion of volatiles and unburned carbon. Jets must be properly placed in the furnace walls to assure good coverage





Smokeless Oil Burner Operation

PROPER COMBUSTION and utilization of liquid fuel must be a finely balanced process if smokeless operation and maximum efficiency and economy are to result. Small commercial oil burners are usually equipped with forced draft or mechanical means of air supply. Adjustment is a one-time matter of properly balancing the fuel and air supply so that maximum combustion efficiency, without creation of smoke, will result.

In industrial installations, however, operation is usually by natural draft. The oil burner atomizes the oil and furnishes primary air introduced with the atomized oil in an intimate mixture. Balance of the air required is natural draft induced through secondary air ports, usually located below the burners on the boiler front.

Smokeless operation results from the combination of adequate preheat, efficient atomization and the correct amount of air introduced in the proper manner plus sufficient furnace volume and time allowed for the process of combustion. Element of time afforded for complete combustion is all important and is governed entirely by the rate of draft prevailing in the furnace. Rate of furnace draft should not exceed one-tenth inch. Air ports should be so designed that adequate quantities of air will be available.

If higher furnace draft is used, unburned oil vapor will be drawn into the boiler tubes where the flame is immediately extinguished and will be drawn through the boiler and out of the stack. Such unburned oil vapor is "smudge" or soot. Being moist and sticky, it can cause untold damage to surfaces and materials on which it is deposited.

Three basic types of oil burning are in general use. Selection of this equipment and method of operation depends entirely on the characteristics of the plant and burner equipment installed or to be installed.

Semi-automatic oil burners are automatic in the sense that they start and stop in response to a boiler pressure switch, operating at a sufficiently high rate of combustion to carry the load by intermittent operation. This results in a cycle of heating and cooling, with considerable fuel loss made necessary by reheating the furnace lining and boiler heating surfaces after each cut-out period.

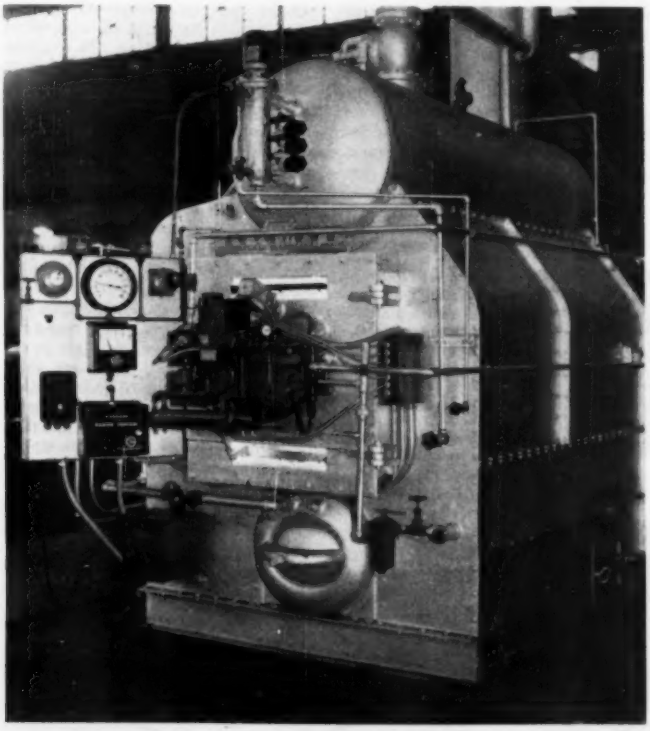
Installations of this type can present an aggravated smoke condition. Such a burner operates at a fixed rate, which may be fairly high. Furnace draft will be high when the burner starts, and a dense cloud of smoke is usually emitted as a high rate of fuel is fed into a comparatively cold furnace. This condition usually prevails for a number of minutes until the furnace brick work is brought up to a temperature that will assist and insure complete combustion.

When no draft control equipment or a fixed draft rate regulator is installed, furnace draft increases very materially when there are no gases of combustion to be evacuated. This high rate of draft, existing at the moment of starting, results in the smoke from the starting puff being drawn rapidly through the boiler and out the chimney.

First step to eliminate this situation—without converting to automatic control—is to adjust the fuel feeding rate to the load in order to secure as nearly constant operation as possible. Each air port should be equipped with a shutter that is interconnected with the valve controlling oil feed, and determine the proper arc of operation of the air port shutter with relation to oil flow by making a gas analysis when operating at several different feeding rates.

Fully automatic oil burning installation is one in which supply of oil and air introduced by the burner and the quantity of secondary air supplied by natural draft are closely controlled and automatically regulated in response to slight changes in boiler steam pressure. Such an installation, when properly adjusted and controlled, will operate indefinitely without causing smoke.

Control of furnace draft, while a component part of the control set, is usually accomplished by separate and independent means. A regulating device positions the uptake or outlet



Preheating heavy fuel oil and proper air supply will keep boiler tubes clean and prevent smoke in oil fired boilers

damper to compensate for any slight changes in draft rate. Regardless of the quality of fuel being fed or of fluctuations in stack draft, the proper rate will prevail to supply the correct quantity of air through the variable opening in the secondary air port.

Instruments are of vital importance in securing the proper adjustment of the control linkage and for subsequently maintaining high efficiency. An overfire furnace draft gage will indicate the quantity of secondary air supplied. A draft gage connected at the boiler outlet indicates by differential, the draft loss through the boiler, which in turn is an index to the boiler's condition. An increased or abnormal draft loss indicates a carbon condition and the need of correction.

In the larger industrial boilers, size and fuel consumption usually dictates the use of complete control. Usual application is the forced draft type of burner, where all combustion air is furnished by, first, primary air fan or by burner induction, and secondly, secondary air supply by forced draft fans, usually utilizing boiler wall temperature for preheat. In such instances the burner setting and the forced draft air supply are usually interconnected, and controls are operated from fluctuations in steam pressure. Draft control is usually by an independent set operating the uptake damper directly from changes in the furnace draft occasioned by a variable combustion rate.

Another type is the large power boiler operating with a fixed air port opening. Automatic control operating from steam pressure regulates oil flowing to the burner and primary air supply concurrently. The outlet damper is interconnected by adjustable linkage and regulates secondary air flow into the furnace by manipulating boiler outlet damper.

CAUSES OF SMOKE IN OIL FIRED BOILERS

1. **Too much oil being fed into a cold furnace on starting, and the consequent failure or partial failure of combustion.**
2. **Insufficient air (indicated by smoky flame), usually as a result of too small an air port or lack of draft.**
3. **Excessive furnace draft, which in combination with incomplete combustion acts to draw the unburned gases (smudge) through the boiler passages and up the stack.**
4. **Faulty atomization, resulting from insufficient preheat (indicated by sparks in flame) or failure to secure sufficient temperature of oil before starting. Also can be result of burner tip condition, by pulsation (pressure difficulty) and by feed line condition (clogged).**
5. **Insufficient boiler draft loss (in water tube boilers) caused by baffle condition.**

Eliminating Smoke When Underloading And Overloading Boilers

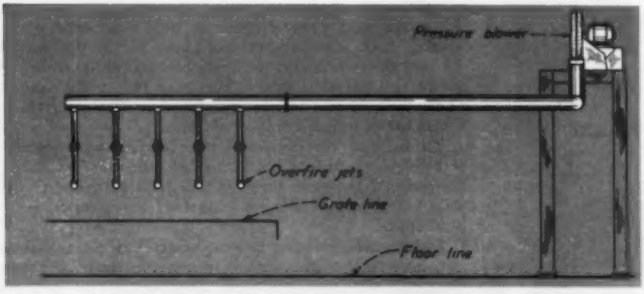
TO eliminate smoke during short periods of under and overload conditions in a spreader stoker fired boiler takes a little planning. This particular steam generating unit consisted of a 3-drum, integral furnace with a 2-distributor power dumping grate spreader stoker. A single high static, low volume, motor driven blower was furnished to supply overfire air, admitted to the furnace through the stoker arches. The same unit supplied air for a cinder return system.

At the normal rating of about 20,000 lb of steam per hr the unit operated satisfactorily, but at the low summer load of about 8000 lb of steam per hr smoking developed. This was probably due to low furnace temperatures existing as the result of over excess air and the lower burning rate.

To correct smoke at the low rate, a portion of the grate was bricked over at the rear and passable smoke performance was obtained. However, this arrangement was not considered satisfactory since almost undivided attention of the operators was necessary.

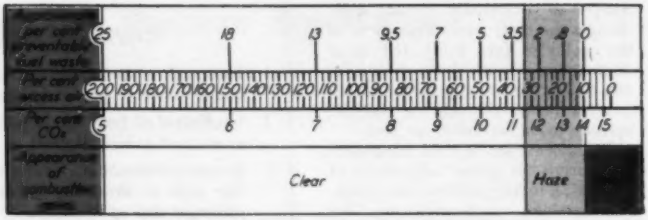
At the high load of about 30,000 lb of steam per hr, with the full grate utilized, smoking was encountered. This was attributed to the lack of turbulence as determined by observing the effects of the front-wall overfire air jets. A supplementary overfire air system was installed.

In the supplementary overfire air system, high static air is admitted 15 in. above the grate line through nozzles staggered, five to a side. Provisions are made for blanking or choking down some of the nozzles, if necessary. Under the extreme high loads, with the supplementary jets in service, smoke emission was quite acceptable, while under normal load conditions the stack conditions continued to be satisfactory. At the low load, with the supplementary jets in service, firing alternate halves of the grate was necessary for best conditions. With the alternate firing method, only the jets adjacent to the side being fired were in operation.



Sets of overfire air jets properly located will aid in reducing smoke. A separate system handles low steam demand

Photoelectric Eye Controls Combustion


Per cent preventable fuel waste
25 18 13 9.5 7 5 3.5 2 .8 0
Per cent excess air
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
Per cent CO_2
5 6 7 8 9 10 11 12 13 14 15
Appearance of combustion gases
Clear
Haze

Most efficient point to hold CO_2 content in flue gases is between 11.5 and 14 per cent. Lower CO_2 content wastes fuel

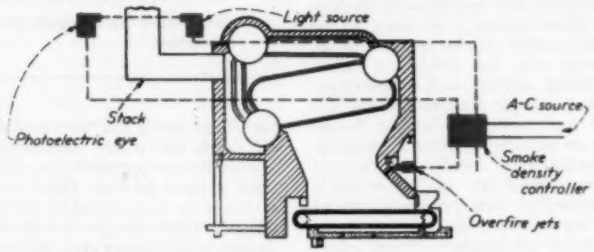
UTILIZING the photoelectric eye permits smokeless operation of a furnace or boiler at high efficiency with greatly simplified combustion control equipment. This unit measures or analyzes only one variable—the visual quality of the products of combustion. When smoke is observed the photoelectric eye operates to control oxygen content of the combustion products of hydrocarbon fuels burned in suspension.

By controlling the haze density of combustion gas, high efficiency is maintained, with preventable stack losses and smoke kept at the minimum.

Exact function of the electric eye and the method of application to plants burning fuel in suspension, vary with the method of firing, the method of supplying combustion air and the speed of load change in the unit fired.

In some cases it functions as both an air flow regulator and a fuel-air ratio control, controlling the total air supply. In other plants it operates only as a fuel-air ratio control, serving as an override, vernier, or corrector to perfect the settings made by other less exact combustion control equipment previously installed. The purpose of such applications is to improve efficiency, eliminate the usual hand adjustments and to avoid occasional or frequent smoky operation periods.

In stoker-fired plants, application is for modulating the control of overfire air or turbulency steam, to improve efficiency and avoid smoke with the minimum amount of steam or air.



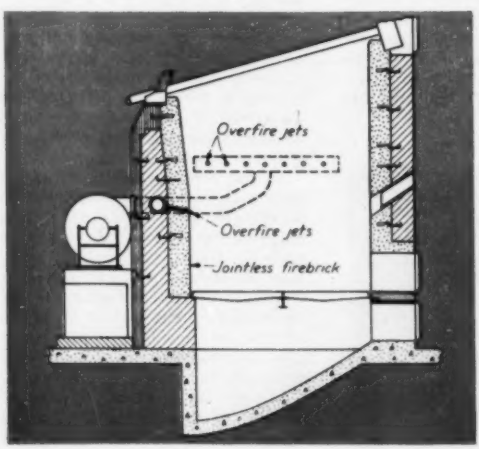
Control system consists of a photoelectric eye and smoke density controller tied into overfire jets or fuel system

Overfire Jets Reduce Smoke When Burning Wood

FIRING a mixture of wood shavings, sawdust, wood scraps and paper frequently results in emission of smoke. Such materials, in this plant, are burned in two 25 hp water tube boilers to supply heat and at the same time utilize this valuable waste. Fuel was fed to the furnace under pressure and burned in suspension. Natural draft resulted in an unusual smoke problem.

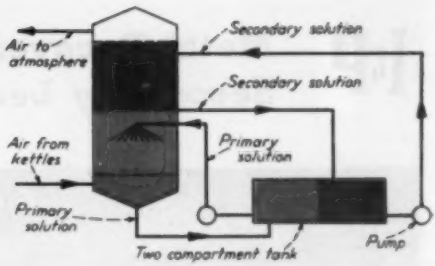
To alleviate this nuisance, overfire jets were installed to provide air and turbulence to burn the volatiles as they formed. At the same time, as unburned particles reduced total heat output, adding the overfire jets increased boiler efficiencies.

Eight nozzles were set into the bridge wall recessed about 1½ in. into the refractory to protect the metal and avoid clogging. Overfire jet is supplied to headers on each side of the furnace and distributed over the fire evenly and in good pattern to reduce smoke density.



Overfire jets, in this installation, were placed strategetically in furnace to assure a good air distribution pattern

Scrubbing Varnish Fumes And Vapors



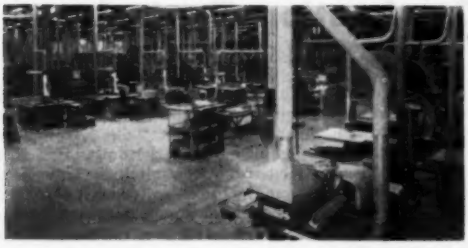
Two different chemicals are employed to remove vapors and fumes from varnish cooking kettles in a two stage collector

REMOVING vapors and odors from varnish cooking, cooling and allied operations has long concerned management of this industry. The system shown in the diagram was installed in such a plant to serve six kettles operating on various "cooks", involving natural and synthetic resins and different types of oils. The collector, fan and motor were selected to handle 6000 cfm, a maximum of 1000 cfm from each kettle. Under conditions where the maximum exhaust was not desirable, a bleed-in at each kettle was automatically opened to maintain a constant velocity in the duct system and a constant air volume through the collector. Maintaining constant designed velocity in the branch and main ducts was desirable to prevent fires from flashing between kettles in the line.

Collector selected was a counter flow type with the gases passing upward through stationary impingement elements with a spiral pattern and constant change of direction. Velocity and direction of the air passing upward breaks up a descending liquid into suitable spray patterns and liquid curtains to achieve proper liquid-vapor contact with a minimum of resistance.

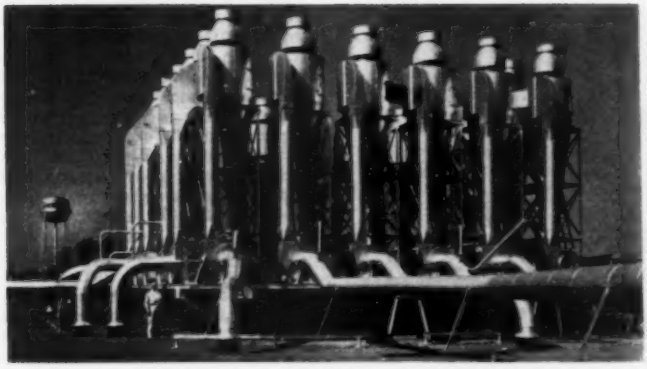
Two liquids are employed for removing contaminants. In the primary contact section an alkaline or similar solution is employed to first condense vapors to the droplet state for removal by impingement, and second to react chemically with organic acids present to remove them. In the secondary contact section a mild oxidizing solution changes residual vapors and gases to a more stable form to further reduce nuisance odors.

A two compartment tank was installed, and recirculated the primary and secondary washing solutions. A standard fan with a 15 hp motor and V-belt drive completes the system. Collected material, that floats to the top of the primary recirculating tank, can be skimmed off periodically and be refined for re-use at a nominal profit.



Inplant air cleaning is a must for employee moral. The machines are hooded to remove the grinding sand

Battery of 36 cyclones collects approximately 100 lb of sand dust per hr Units are installed on the plant roof



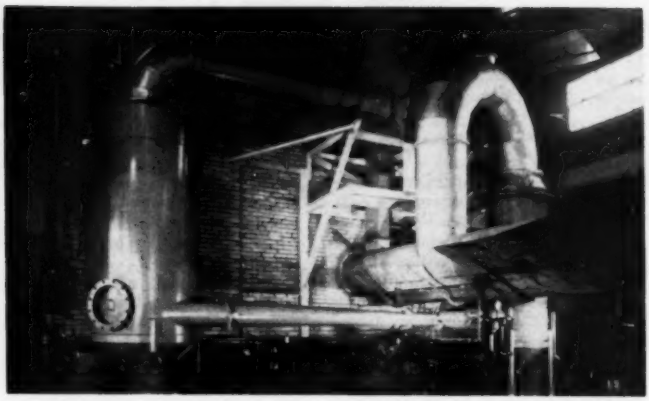
Inplant Air Pollution

INPLANT air pollution can be a great problem when considering the health of the worker and expense of general housecleaning. Such a problem existed in a large machine shop where the dust loading was 0.44 gr. After installing properly designed hoods for all micro-sanding machines, necessary dust work and cyclone collectors loading was reduced to 0.0038 gr.

This system collects approximately 100 lb of dust per hr, and tests indicate that only 8 oz per hr is discharged to the atmosphere. Test analysis of the particulate entering the collectors indicated 69.9 per cent above 60 micron Density of the particulate was 1.40.

Management at this plant has corrected inplant air pollution, and at the same time reduced plant maintenance. Eventually the system will pay for itself from the savings in labor cost.

Metal Recovery From Secondary Lead Smelting



SUCCESSFUL installations, utilizing a venturi scrubber, have been made for the removal of fumes from the gas discharges of reverberatory furnaces charged with type metal dross containing lead, tin and antimony. Recent tests made on such a system indicate collection efficiencies of 98-99 per cent, on a weight basis, have been obtained. Mean particle size was in the 0.5 micron range, with many particles in the range of 0.1-0.25 micron.

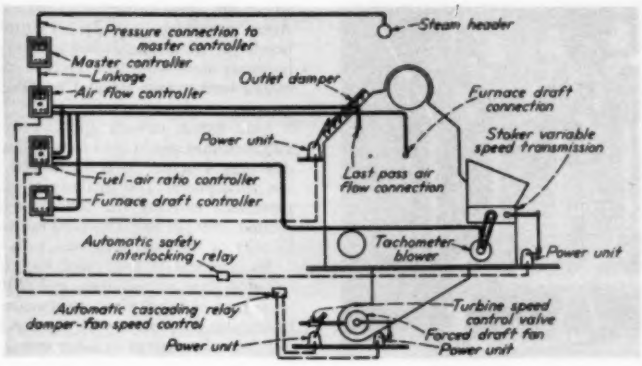
Two such installations have been made, each designed to handle approximately 10,000 cfm at 1000 F while injecting 35 gpm of water through radial jets, at the throat of the venturi. With an average dirty gas dust loading of 12 grain per scf, actual tests have shown the scrubber outlet gas dust loading to be in the range of 0.11-0.17 grain per scf.

The usual heavy, canary yellow stack discharge from these furnaces was reduced so that the discharge was essentially steam, with complete dissipation of the visual plume within a distance of 100 ft.

Controlling Smoke Emission With Automatic Combustion Controls

ONE means of alleviating smoke of a boiler is to install automatic combustion control. These control systems can be operated by air, electricity or a combination of both. A typical example of such a combustion control system is one installed in a power plant located in St. Louis, Mo.

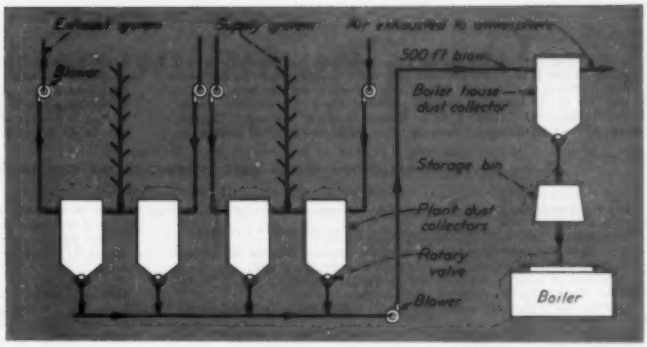
This particular system, a chain grate stoker, is all electrically operated and consists of four units for the control of steam pressure, air flow, fuel feed and forced draft. Power units are utilized to operate the forced draft inlet damper, forced draft fan turbine valve, stoker drive and boiler outlet damper. Complete operation is through a master control connected to the steam header at a point where steam pressure is to be maintained relatively constant.



This master unit adjusts the air flow controller for the required rate of air flow through the boiler. This latter control measures the draft loss across the boiler by controlling the air volume from the forced draft fan. A fuel feed ratio controller operating in conjunction with a tachometer blower (driven by a variable speed shaft of the stoker drive) measures the drop in draft across the boiler. It controls the rate of stoker speed as represented by the suction of the tachometer blower and proportions fuel feed and air flow.

Furnace draft controller is connected to the furnace and maintains a constant predetermined draft in the combustion chamber by operation of the boiler outlet damper. The fan damper during normal load conditions is wide open. As the load decreases, the fan speed is automatically decreased until the safe minimum speed is reached. At this point the forced draft fan is automatically transferred from fan speed control to the operation of the damper. With a further decrease in load this damper is closed automatically as much as may be required to control the air volume.

Sawdust Removal And Burning



CONFRONTED with inplant pollution caused by sawdust and extensive winter fuel costs, this furniture manufacturing plant installed cloth type collectors, cleaned the plant air and recirculated it to provide ventilation. Extensive wood manufacturing made possible the utilization of sawdust, wood chips and scrap as a primary boiler fuel.

Originally 70,000 cfm of air was exhausted from collectors in the removal of sawdust from the plant. However, the collectors were obsolete and hood equipment proved quite inefficient. Not only was the inplant air pollution a problem, but sawdust escaping from the collectors caused objections from neighbors. In addition, the heating load on the boilers resulting from exhausting 70,000 cfm of air, ran the fuel costs to untold heights.

Management, after careful consideration, planned a completely new exhaust and collector system and bought boilers equipped with furnaces to handle the collected wood wastes and operate with oil as a standby fuel.

Four cloth dust collectors were installed to handle the plant wood waste. These units discharged into a common pneumatic conveying system and the waste was conveyed to a fifth dust collector located on top of the boiler house. The latter cloth collector supplies fuel direct to the boiler.

Efficiency obtained with the cloth collector indicated that the air would be clean enough to permit recirculation to the plant, thus the heat load was lowered considerably, and the manufacturing space was placed under a slight pressure. Aside from the efficient removal of wood waste and cleaning up a pollution problem, a saving of 33 per cent was made in the over-all fuel costs.

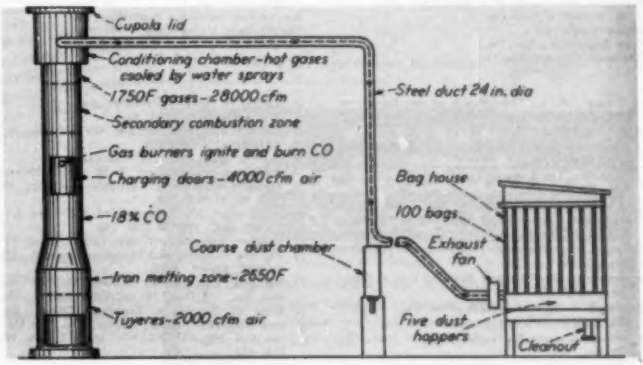
Iron Oxide Fumes Collected In Two Stages

IRRITATING smoke from foundry furnaces can be successfully curbed in silicon impregnated fiber glass bag collectors. Some 450 lb of solid material are collected daily at this plant, that otherwise would be added to the general air pollution. Allowable emission of 10 lb per hr of dust and fume under the local condition was more than satisfactorily met.

An analysis of the emissions were found to be approximately 50 per cent silicate oxide, 30 per cent iron oxide and about 20 per cent lime, manganese and sodium oxides. In all, approximately 50 lb of material is collected each hour of cupola operation. Temperature of the exhausted gases averages 500 F, and the specially constructed porous bags will stand temperatures to 750 F.

Cleaning process consists of two stages. A primary wet scrubber eliminates about 30 per cent of the coarse particles and cools the hot gases from 1700 F to approximately 1000. The secondary bag collector is located 100 ft from the scrubber, and the gases passing between these two collector units causes the temperature to be reduced by radiation to 500 or 650 F.

A blower in the bag house sucks the furnace gases through the duct into 100 fiber glass bags each 15 ft high and 12 in. in dia. Each bag acts as a vacuum filter capturing these minute particles. 13,000 cu ft of smoke are handled per min at a temperature of 500 F.



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THE FOLLOWING PAPERS WERE REVIEWED IN THE PREPARATION OF THIS REPORT

"Air Pollution is Growing Problem of Many Western Cities", S. E. Blewett, Western City, April 1949.

"Atmospheric Pollution", Engineering, March 1949.

"Control of Atmospheric Pollution", M. Katz, Water & Sewage, Nov. 1949.

"Foundry and Air Pollution", J. P. Ahern, Foundry, Oct. 1949.

"Detection of Lead in Air with Aid of Geiger-Mueller Counter", O. G. Koppius, Optical Society America, April 1949.

"Dust Control in Ceramic Industries", W. C. L. Hemeon, American Ceramic Society, March 15, 1949.

"Cincinnati's Smoke Inspection Law", R. B. Lemkuhl, Nat. Engr., Sept. 1949.

"Engineer's Place in Smoke Abatement", H. B. Lammers, Nat. Engr., Oct. 1949.

"Cooperation Curbs Smoke Nuisance", W. J. Lewis, Nat. Engr., Dec. 1949.

"Air Pollution and Particle Size—Toxicity Problem", H. E. Stokinger and S. Lastin, Nucleonics, Dec. 1949; March 1950.

"Air Pollution by Industrial Fumes, Gases and Dusts", J. C. McCabe, Min. Eng., Sept. 1950.

"Air Pollution Control", J. C. McCabe, Illinois University Eng. Experiment Station, Sept. 1949.

"What Can Be Done to Reduce Escaping Solids from Stacks Exhausting High Temperature Gases from Furnaces, Kilns, Roasters, Dryers, Etc.", J. M. Kane, American Soc. Mech. Engrs., Advance paper N50-PRI 11 for meeting April 24, 1950; Southern Power & Industry, July 1950.

"Chicago Classifies and Measures Dust Deposited Over City", Iron Age, July 21, 1949.

"Air Pollution by Industrial Fumes, Gases and Dusts", J. C. McCabe, Min. Eng. Trans., Sept. 1950.

"Agglomeration of Smoke, Fog or Dust Particles by Sonic Waves", H. W. St. Clair, Ind. & Eng. Chem., Nov. 1949.

"Air Pollution Prevention in United States", J. F. Barkley, Mech. Eng., April 1951.

"Processes for Removal of Hydrogen Sulfide From Industrial Gases", The Oil and Gas Journal, January 1951.

"Disposal of Fumes and Odors", Paint, Oil and Chemical Review, Dec. 22, 1949.

"Air Pollution — Major Problem for Industry", Iron Age, July 13, 1950.

"Sulphur From California Hydrogen Sulphide", Petroleum Engineer, Aug., 1949.

"Smoke Measurement in a Fuel Oil Test Unit", Heating, Piping and Air Conditioning, November 1950.

"The Data Book on Combustion Control Systems for Industrial Boilers and Furnaces," General Power Plant Corp.

"Adequate Dust Control Keeps Foundry Clean", A. D. Brandt, American Foundryman, Dec. 1948.

"What Can Small Plant Do About Fly Ash", C. E. Miller, Nat. Engr., June 1949.

"Atmospheric Contamination and Purification", Indus. & Eng. Chem., Nov. 1949, Dec. 1949. Symposium: "Smoke and Fume Investigations", R. E. Swain; "Dust and Fume Standards", L. C. McCabe, A. H. Rose, W. J. Hamming and F. H. Viets; "Legal Regulation of Air Pollution", M. L. Hartmann; "Measurement of Visibility by Photographic Photometry", C. Steffens; "Location of Dust Producing areas", W. L. Chen and H. B. Charmbury; "Dissemination of Aerosol Particles Dispersed from Stacks", I. Baron, E. R. Gerhard and H. F. Johnstone; "Dispersion of Gases from Tall Stacks", M. D. Thomas, G. R. Hill and J. N. Abersold; "Deposition of Aerosol Particles from Moving Gas Streams", H. F. Johnstone and M. N. Roberts; "Development of Venturi Scrubber", W. P. Jones; "Electrical Precipitation and Mechanical Dust Collection", W. A. Schmidt; "Agglomeration of Smoke, Fog or Dust Particles by Sonic Waves", H. W. St. Clair; "Industrial Sonic Agglomeration and Collecting Systems", H. W. Danner and F. Neumann; "Exhaust Ventilation for Solid Materials Handling", R. T. Pring, J. F. Knudsen and L. Dennis; "Sulphur Dioxide in Atmosphere and in Its Relation to Plant Life", M. Katz; "Los Angeles Smog Problem", P. L. Magill; "Industrial Dusts and Fumes in Los Angeles Area", J. C. McCabe, P. P. Meder, H. E. McMahon, W. J. Hamming and A. L. Chaney; "Dilution of Waste Stack Gases in Atmosphere", P. E. Church.

"Current Trends in Fly Ash Recovery", R. O'Mara, Combustion, April 1950.

"Eliminate Stack Dusts and Mists", H. W. Danner, Jr., Chem. Eng., May 1953.

"Measuring Smoke Density", P. S. Dickey, Electronics, April 1950.

"Smoke-Density Measurement", W. F. Stoecker, Mech. Eng., Oct. 1950.

"Modern Use of Exhaust Ventilation", J. G. Liskow and J. Berquist, Foundry, Sept. 1950.

"Control of Plant Smoke and Waste Creating Big Cost Problem", J. Anthony, Iron Age, June 30, 1949.

"Los Angeles County Air Pollution", T. L. Harsell, Jr., and F. L. Stamm, Western Metals, Jan. 1951.

"Present Status of Air Pollution Research", H. P. Munger, Amer. Soc. Mech. Engrs., Advance Paper N50-A151 for meeting Nov. 26 - Dec. 1, 1950, Mech. Eng. May 1951.

"Dust Collection Alteration Effects 33% Saving in Heat", D. E. Behrens, Industry & Power, Dec. 1950.

"Fundamentals of Smoke Abatement", J. F. Barkely, U. S. Bureau of Mines Information Circular 5788, Dec. 1950.

"Air Pollution and How to Measure It", J. W. Shaw and J. Linsky, American City, Oct. 1950.

"Technical Aspects of the Los Angeles Smog Problem", H. F. Johnstone. Reprinted from The Journal of Industrial Hygiene and Toxicology, Vol. 30, No. 6, November 1948.

"The Inservice Training Course in Air Pollution", Lectures presented at the University of Michigan School of Public Health, Feb. 6, 7, and 8, 1950.

"Smoke Abatement: Current Practices and Regulations", The American Municipal Association.

"A Study of Smoke and Air Pollution in the Kanawha Valley", Coal Producers Committee for Smoke Abatement, 1949.

"Air Pollution and Smoke Prevention Association of America, Inc. Proceedings, 43rd Annual Convention", 1950.

"Smoke Its Cause, Cost and Prevention for Power and Heating Plants." Prefix Corp.

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1. Prosser, W. L., "Handbook of the Torts", p. 549, (1941), West Publishing Co.
2. Ibid, p. 553.
3. American Jurisprudence, v. 39, p. 300, Bancroft Whitney Co.
4. Judson v. Los Angeles Suburban Co., 157 Cal. 168, 106 Pac. 581.
5. American Jurisprudence, v. 39, p. 309.
6. People v. Detroit White Lead Works, 82 Mich. 471, 46 N.W. 735.
7. Nord, M., Chemical Industries, 67, p. 394, Sept. 1950.
8. American Smelting and Refining Co. v. Godfrey, 158 F. 225.
9. Wente v. Commonwealth Fuel Co., 232 Ill. 526, 83 N.E. 1049.
10. Arizona Copper Co. v. Gillespie, 12 Ariz. 190, 100 Pac. 465.
11. Bentley v. Empire Portland Cement Co., 48 Misc. 457, 96 N.Y. S. 831.
12. Hulbert v. Calif. Portland Cement Co. 161 Cal. 239, 118 Pac. 928.
13. Stark v. Coe, 134 S.W. 373 (Tex.)
14. American Jurisprudence, V. 39, p. 335.
15. McCarty v. Natural Carbonic Gas Co., 189 N.Y. 40, 81 N.E. 549.
16. McClung v. North Bend Coal and Coke Co., 9 Ohio C.C. 259, 40 C.D. 243.
17. 6 Amer. Law Reports 1575.
18. Sullivan v. Jones and Laughlin Steel Co., 200 Pa. 540, 57 Atl. 1065.
19. Madison v. Ducktown Sulphur, Copper and Iron Co., 113 Tenn. 331, 83 S.W. 658.
20. State of Georgia v. Tennessee Copper Co. and Ducktown Sulphur, Copper and Iron Co., 206 U.S. 230, 237 U.S. 474, 237 U.S. 678, 240 U.S. 650.
21. Nord, M., Chemical Industries, 67, p. 893, Dec 1950.
22. Nord, M., Chemical Engineering, 58, p. 111, May 1951.

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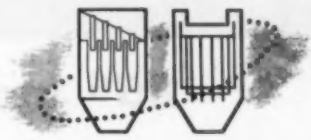

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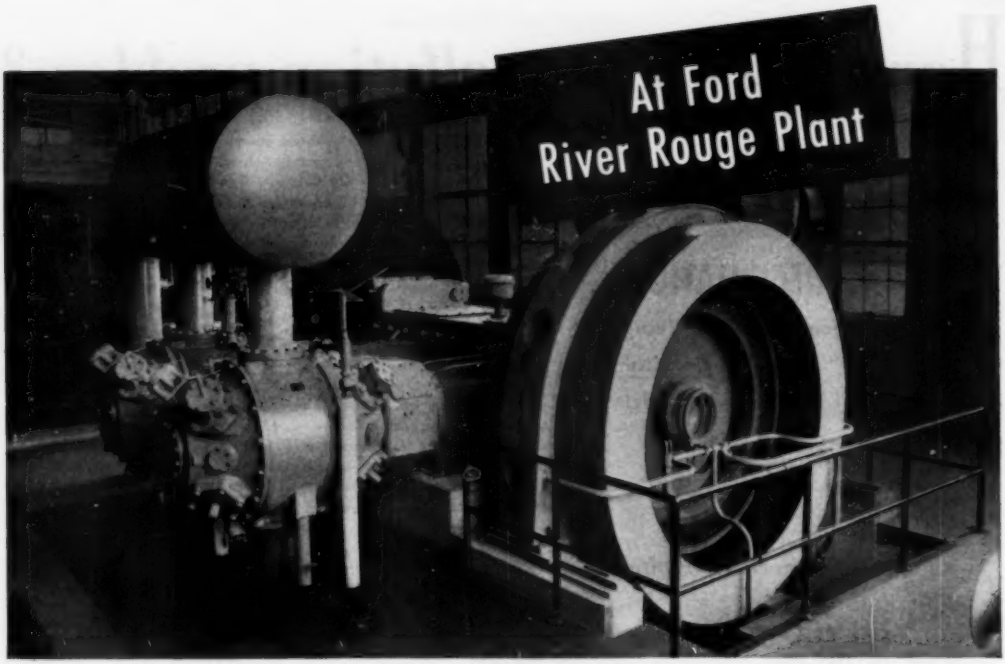

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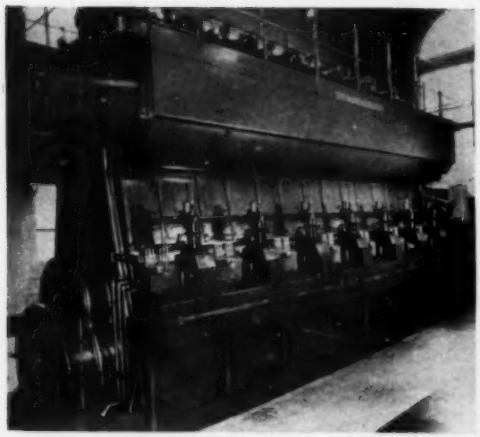


This 3000-hp, two-cycle, mechanical injection diesel has increased overall station output to 12.66 kwh per gal of fuel

Switchboard at left was installed to handle the operation of the new and larger diesels generating electrical power

PIERRE'S POPULATION INFLUX REQUIRED DIESEL ADDITION

Even though the Pierre, S. D. area will have a hydro-electric plant along about 1960, a new 3000-hp diesel was installed to handle present day peak loads. In the future, the municipal diesel generating plant will act as a capable standby

ROY B. BAKER, *City Engineer, Pierre, South Dakota*

PIERRE, capital of South Dakota, is a city with a ten-year problem. Located on the east bank of the Missouri River, the city is near the site of the giant Oahe dam on which work was started in July 1950 and scheduled for completion in 1960. Already expanding at a better than normal rate, the dam project brought Pierre a swift influx of population. The city grew 32 per cent between the 1940 and 1950 census counts with a large portion of the increase concentrated in the last year or two.

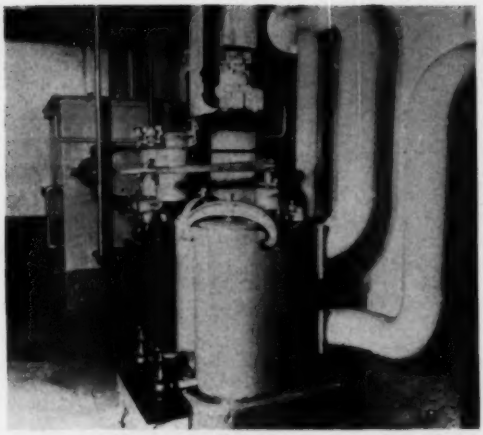
Expansion was equally essential at the municipal power plant where load was soaring above firm capacity, with every indication of continuing growth. There would be plenty of hydro power available in 1960 when the Oahe dam's 140,000 kw generators started turning, but for the next ten years the load would have to be carried by the Pierre Municipal diesel plant. The city needed a large engine, capable of handling a heavy operating schedule for 10 yr with all possible efficiency and dependability. At the end of that period, sound power policy dictated maintenance of an adequate standby plant.

Pierre officials decided upon a 3000-hp, 7 cylinder, 21½ in. bore by 31 in. stroke, trunk piston, two-cycle, mechanical injection diesel developing rated horsepower at a moderate 225 rpm. This unit went into service on Dec. 20, 1949 and immediately started on a program of efficient power generation.

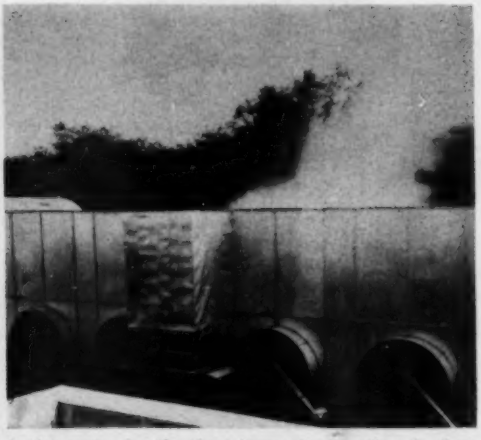
In 1950, the first full year of operation, the engine ran a total of 4186 hr and produced 5,029,000 kwh of the plant's total of 10,004,400 kwh. During this period, the unit consumed 359,751 gal of fuel, a notable average of 13.978 kwh per gal. In producing the remaining 4,975,400 kwh, the plant's other diesels consumed 430,511 gal of fuel for an average of 12.66 kwh per gal.

A thorough investigation of operating data for each of the last five years —including department revenues, itemized generating expense, cost of distribution, street light maintenance, commercial department, general and depreciation—shows the net profit in 1950, after deduction of the allowance for depreciation, to be $100,845.39. Though this was by far the largest profit in its history, the plant has been consistently profitable with a five-year net of $324,593.07. In the past decade, the electric department has turned over to the city more than $500,000 for use in the general fund and payment of general city obligations.

Pierre has had a municipal power plant since 1911 and the present plant dates back to 1931 when two 750-hp air-injection diesels were installed. A 1000-hp solid-injection unit was added in 1935 and a 2000-hp solid-injection unit in 1946. Then in 1949, the city switched to two-cycle diesels. The big engine drives a 2100-kw, 4160-v generator with chain-driven exciter. All the rest of the plant operates at 2300 v. Scavenging air for the new unit is supplied by a high-speed rotary blower driven by a 250-hp electric motor. Power for this motor is provided



Detergent type lube oil is cooled and cleaned in this equipment to aid in keeping the new diesel in top working order



Jacket water for the three large diesel engines is circulated through the coils in this forced-draft cooling tower

through a direct line to the engine's alternator. A battery set forces the generator field and insures a quick surge of power when the generator begins to turn.

Air is cleaned by a 20-cell impingement-type filter in a chamber in the blower room. In summer, air is drawn directly through a pipe that extends through the roof. In winter, air is warmed in a jacket around the exhaust silencer.

All diesels burn a Wyoming fuel oil of 25-26 gravity. Delivered by tank car, the oil is transferred by a motor-driven unloading pump to four 20,000 gal underground storage tanks. Float-controlled motor-driven pumps move the oil from storage to a 500 gal tank in the engine room after which the fuel flows by gravity to the 200 gal day tanks in the basement. Engine-driven supply pumps pick up the oil from the day tanks through individual meters.

Steam heat is needed to permit unloading the viscious fuel in cold weather, and in addition two storage tanks are equipped with steam heating coils. A waste heat boiler in the exhaust system of the 2000-hp diesel provides steam for this purpose and is supplemented when necessary by a small oil burner.

Detergent oil is employed in lubricating the big engine. SAE 40 lube is fed to the cylinders by individual mechanical lubricators, while SAE 30 is circulated to the bearings and pistons (as a coolant) by an engine-driven pump. A shell-and-tube oil cooler is included in this circuit. A motor-driven auxiliary lube pump is arranged to start automatically if the main pump fails. Oil is drawn from the sump continuously by a motor-driven pump and put through a 20-element cellulose filter, then returned to the sump. Filter elements are changed every 2000 hr. An inspection after 4000 hr of operation showed the engine to be perfectly clean. Needless to say, lube oil is checked more often and has been found to be in excellent condition.

Jacket water for the three largest engines is circulated through coils in a forced draft cooling tower, which has fans automatically controlled to maintain the desired water temperature. Four 600 gpm motor-driven centrifugal pumps handle the jacket water and three similar pumps circulate raw water for the tower. Make-up water is drawn from city mains and treated with chemicals.

A gage board beside the new diesel holds an exhaust pyrometer along with pressure and temperature alarms for cooling water, engine lube oil and blower lube. There are also push-button switches for control of auxiliary equipment.

All through 1950, the plant built toward a production of 1,000,000 kwh a month and finally topped that mark in January 1951. Production for 1950, totaled 10,004,400 kwh. Fuel consumption was 790,399 gal for an average production of 12.65 kwh per gal. As the growing load permits operation of the new unit at a more favorable load factor, plant efficiency is expected to improve above this average. But even at present fuel consumption levels, Pierre is turning out power at a substantial profit.

PRINCIPAL EQUIPMENT AT PIERRE, S. D. DIESEL PLANT

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Generator	General Electric Co.
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Governor	Woodward Governor Co.
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Transfer pump	Viking Pump Co.
Fuel meter	Pittsburgh Equitable Meter Co.
Fuel filter	Wm. W. Nugent & Co., Inc.
Lube oil	Standard Oil Co. (Ind.)
Lube oil filter	Briggs Filtration Co.
Lube oil cooler	Ross Heater & Mfg. Co., Inc.
Cooling tower	Diesel Service Co.
Jacket water pumps	Bell & Gossett Co.
Raw water pumps	Bell & Gossett Co.
Air filters	American Air Filter Co., Inc.
Silencer	Maxim Silencer Co.
Air compressor	Worthington Pump & Machinery Corp.
Gage panel	Nordberg Mfg. Co.
Alarm panel	Viking Instruments, Inc.
Pyrometer	Illinois Testing Laboratories, Inc.
Switchboard	Westinghouse Electric Corp.
Fuel pumps	American Bosch Corp.
Cylinder lubricators	Manzel, Inc.
Hoist	Manning, Maxwell & Moore, Inc.

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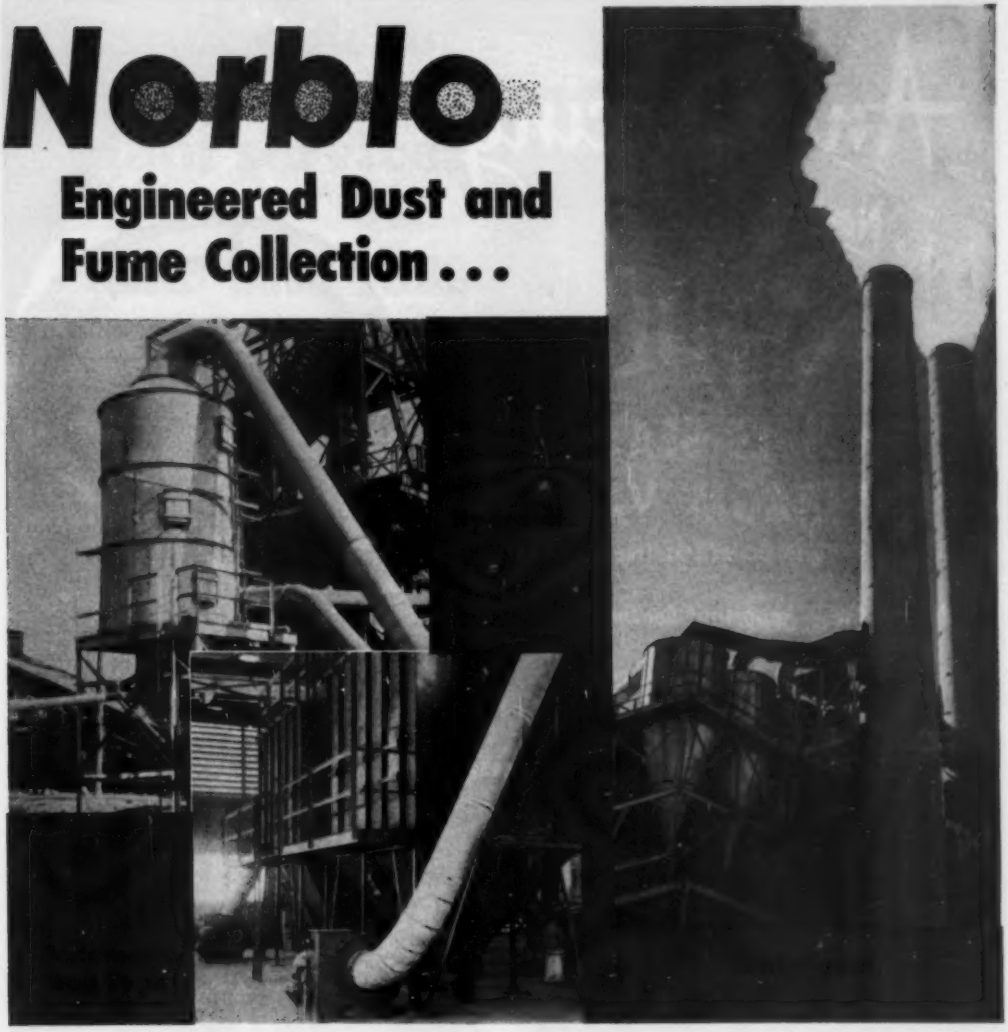

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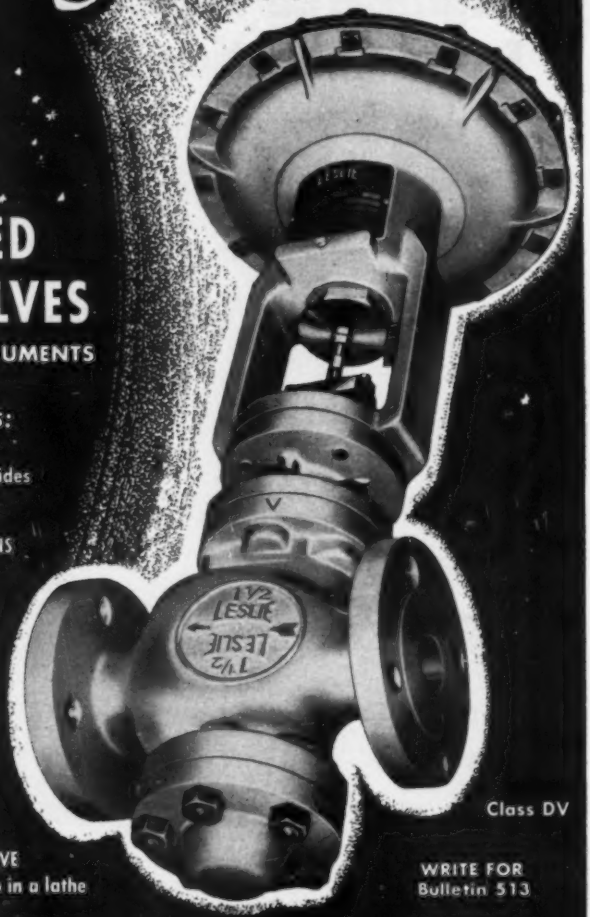

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Methods, data and ideas that make excellent references in solving engineering problems frequently encountered in plant operations

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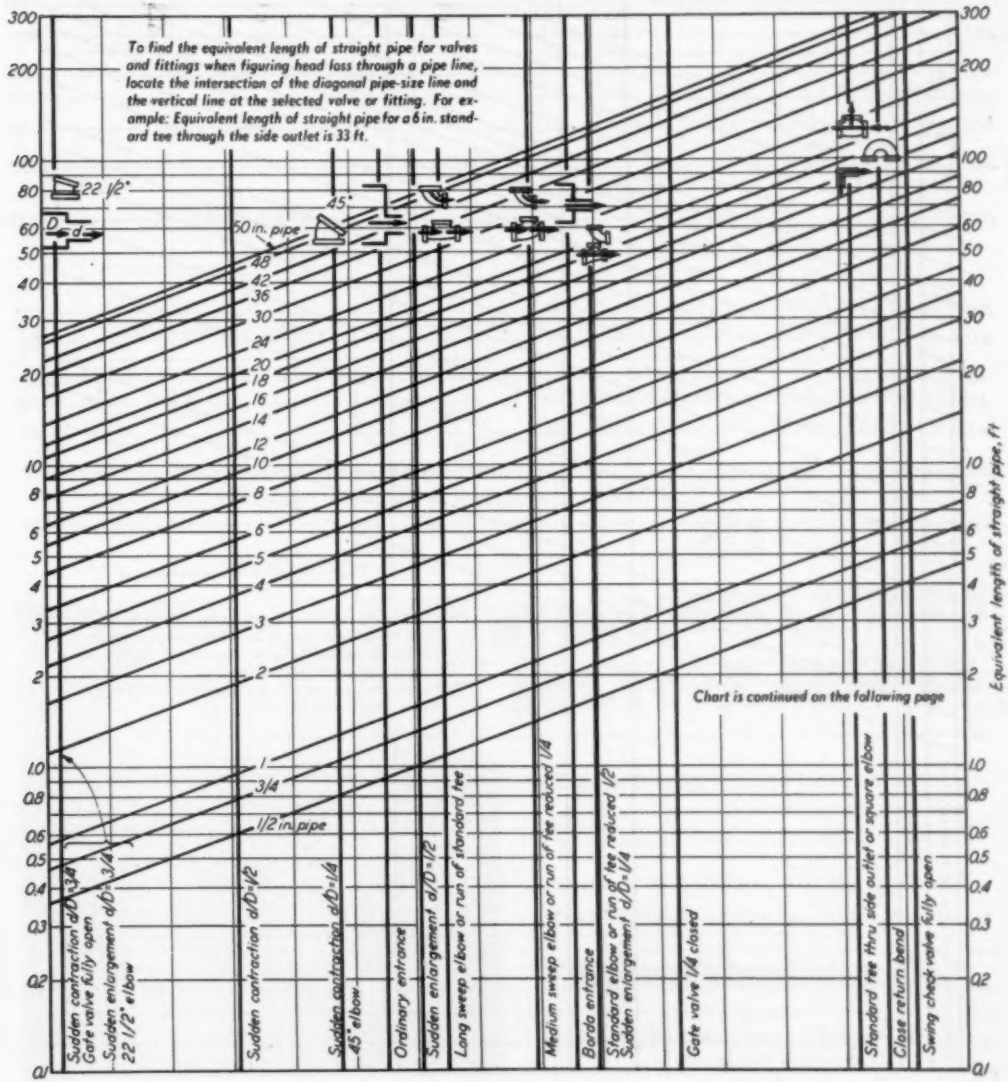
JAMES C. M. TILLINGHAST, *Associate Civil Engineer, Commonwealth of Massachusetts*



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(Continued from page 105)

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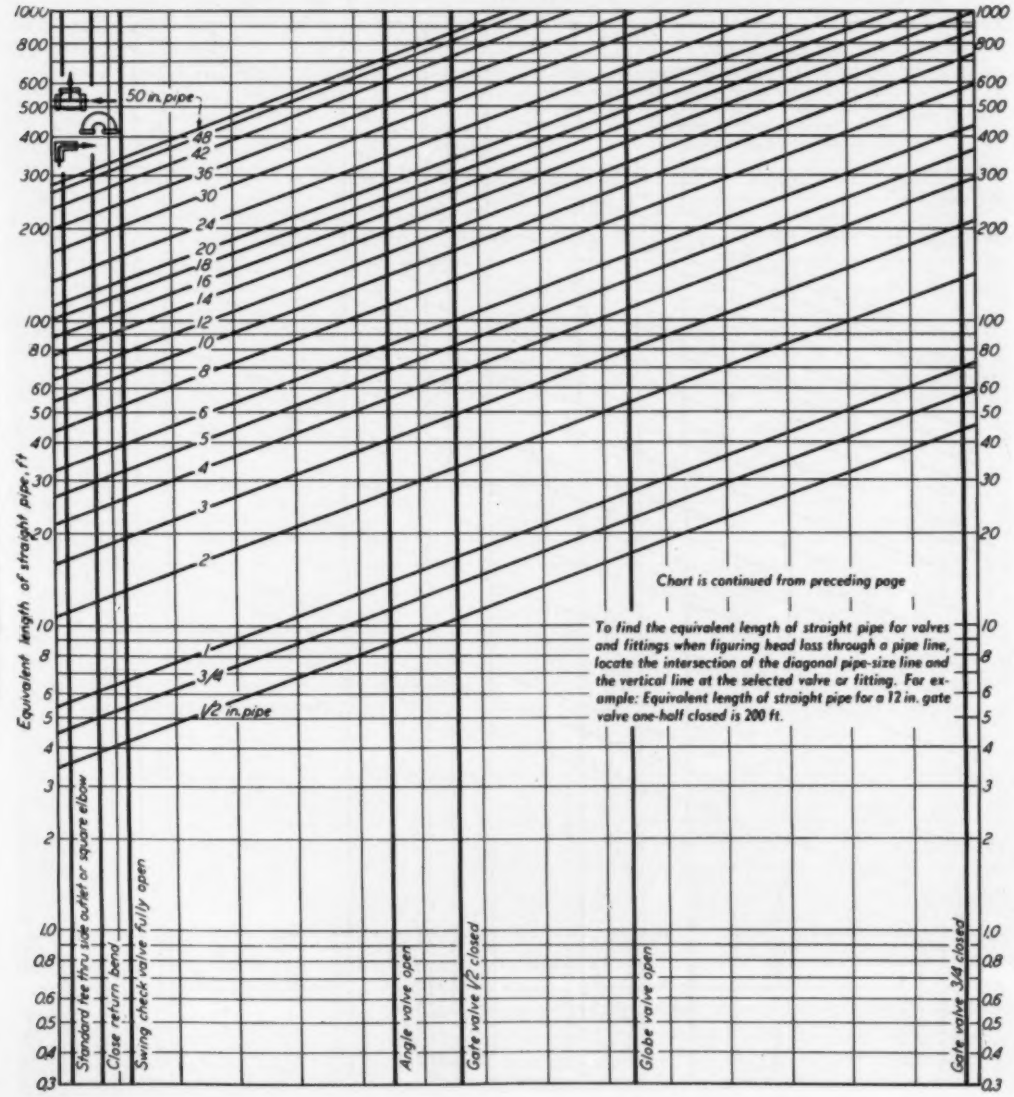

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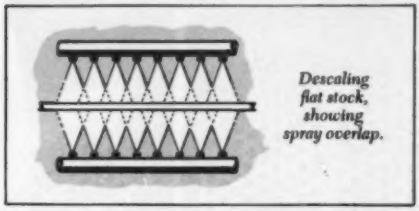
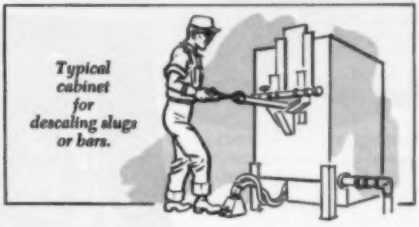


Descaling flat stock, showing spray overlap.

Effective descaling need not be a slow, costly manual or mechanical process. With hydraulic descaling you can efficiently knock off scale with high velocity jets of water in a matter of seconds!

The heart of the hydraulic system is the pump which delivers the high pressure water. The BJ Hydropress pump is ideal for this type of work because of its unique construction features. It does not require relief valves, accumulators or extra heavy fittings and piping. Its double volute design creates inherent balance at all heads and capacities.



Typical cabinet for descaling slugs or bars.

Its vertical construction allows the use of a simple foundation and a minimum of floor space.

For more information on how BJ may solve your pumping problems, call your local BJ sales engineering office today!

BJ HYDROPRESS PUMPS ARE YOUR ANSWER

These BJ Hydropress pumps provide capacities to 300 gpm and pressures to 3000 psi. One pump can serve a number of descaling cabinets or booms.

Write for BJ Hydropress Bulletin No. 48-6400. No obligation, of course.

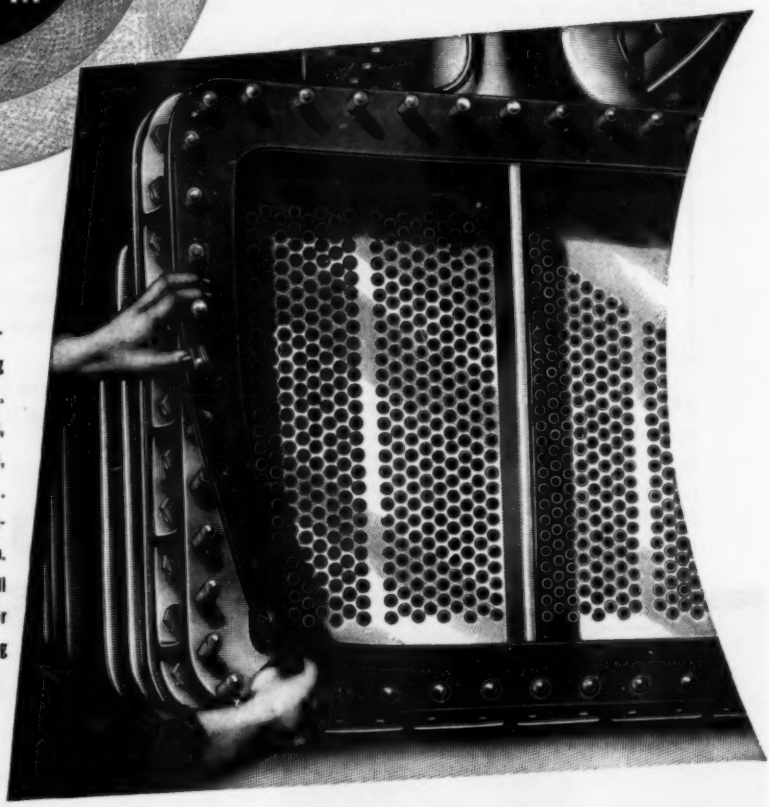
Byron Jackson Co.

Since 1872

P. O. Box 2017 Terminal Annex, Los Angeles 54, Calif.

OFFICES IN PRINCIPAL CITIES

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH R/M



Gaskets like this for Freon condensers may not be your packing problem, but whatever it is . . . high pressures, high temperatures, chemicals, refrigerants, petroleum, food or other products . . . Raybestos-Manhattan has a packing or gasket designed for the job. Your nearby R/M distributor will help you solve your problem. Or write for the new R/M Packing Catalog.

R/M

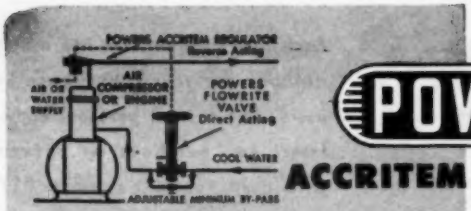
PACKINGS

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

Factories: Bridgeport, Conn., Manheim, Pa., Passaic, N.J., No. Charleston, S.C., Crawfordsville, Ind., Peterborough, Ontario, Canada

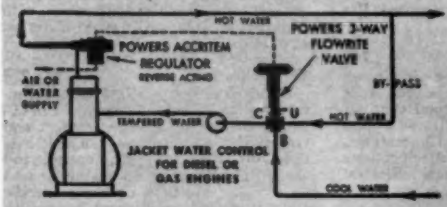
RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Powdered Metal Products • Bowling Balls



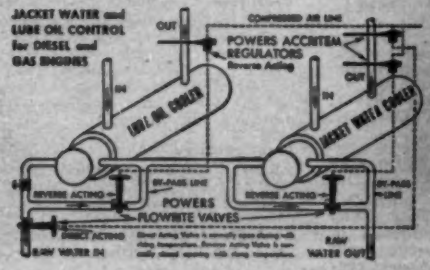
POWERS

ACCRITEM REGULATOR

Unsurpassed for reliability and power to operate large or small size 3-way or 2-way diaphragm valves for accurate control of jacket water and lube oil cooling temperatures.



Only a few of many applications are shown here.



Easy to adjust

Compressed air or water operated

Gives Accurate, Low-Cost Heat Control

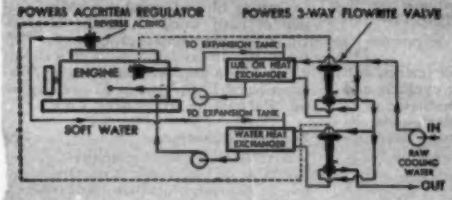
Use Accritem Regulators to control diaphragm operated valves or dampers. They save labor, stop losses caused by over-heating and have the following—

IMPORTANT ADVANTAGES

- ***Adjustable Sensitivity*** and over-heat protection.
- ***Calibrated Dial*** temperature adjustment.
- ***Simple, Rugged Construction*** withstands vibration and insures many years of reliable service.
- ***Temperature Ranges*** 50 to 250° F. and 150 to 350° F.
- ***Easy to Install*** Requires 15 lb. supply of compressed air or water for its operation.
- ***Small Size***—regulator head is only 2⅞" x 3⅝", sensitive bulb is 12" long with ½" I.P.S. connection.

Proper Cooling Temperatures assured by Powers Accritem Regulators • Makes ignition easier • Prevents rapid breakdown of lube oil • Decreases cylinder and piston ring wear • Reduces danger of piston seizure • Lowers fuel and lube oil consumption

FLOWRITE and METAFLOW Diaphragm Valves controlled by a POWERS ACCRITEM HEAT REGULATOR provide an unbeatable combination for *better control* and *lower maintenance*



Write for Bulletin 316—or phone our nearest office for prices and further information about POWERS ACCRITEM regulators and diaphragm valves.

THE POWERS REGULATOR CO.

SKOKIE, ILL. • OFFICES IN OVER 50 CITIES • See Your Phone Book

CHICAGO 13, ILL., 3819 N. Ashland Ave. • NEW YORK 17, N.Y., 231 E. 46th St.
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MEXICO, D. F., Apartado 63 Bis.

AND **60 Years of Temperature and Humidity Control**

Literature on air pollution

Latest bulletins and catalogs from leading manufacturers

Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Insert key numbers on return post card found on page 131

Cloth Filtration **700**

Information pertaining to design features, capacities, dimensions and recommended applications for cloth filter air cleaners is contained in 36-page catalog 72-B. Many typical installations are illustrated and discussed. Also includes valuable tables on friction loss in round pipes, air volumes in pipe lines at varying velocities, and conversion of velocity to velocity pressure. American Wheelabrator & Equipment Co.

Dust Collector **701**

Aerodyne dust collector is based on a principle of aerodynamic separation. Design features, performance data, advantages and applications are illustrated and discussed in 16-page brochure. Aerodyne Development Corp.

Cloth Filter Air Cleaner **702**

"Industrial Dust Control", 24-page booklet 98, presents general information on control of dust in the plant. Principle of operation, engineering specifications, capacities, and typical installations of a continuous cloth filter air cleaner are discussed and illustrated. W. W. Sly Mfg. Co.

Tubular Collector **703**

Principles of operation and design features of two types of cyclonic tube dust collectors are discussed in 16-page catalog 2505. Performance and dimensions are included. Also discusses the problem of fly ash collection in general. Prat-Daniel Corp.

Tubular Collector **704**

Aerotec tubular collector is featured in illustrated 20-page catalog 601. Fly ash control, efficiencies and dust collection requirements are discussed. Principles of operation, dimensional and engineering data, erection methods and special layouts are included. The Aerotec Corp.

Dust Collection **705**

"The Collection and Recovery of Industrial Dusts", 28-page brochure 101, explains what dust is, techniques in the analysis of dust, and factors which influence choice of collection equipment. Information on cyclone, electric precipitator, low resistance and low draft loss collectors is presented. Combination systems, special purpose collectors and hopper valves are also discussed. Buell Engineering Co.

Electrical Precipitator **706**

Cottrell electrical precipitator may be used for removal of practically any solid or liquid suspended in a gas, according to 28-page brochure. How it works, basic types and advantages are illustrated and discussed. Numerous specific installations are presented. Research Corp.

Electronic Air Cleaner **707**

Precipitron, an electronic air cleaner for removal of dust, dirt, smoke, soot and other solids from normal ventilating air is presented in illustrated 8-page pamphlet SA-6691. Special features, typical applications, and specifications are included. Westinghouse Electric Corp., Sturtevant Div.

Dust Recorder **708**

Continuous record of dust content is possible with combination of photoelectric type analyzer and electric recorder. May be used as continuous check on the operation of precipitators. Description of equipment together with operation and application data are presented in illustrated data sheet 10.14-6. Minneapolis-Honeywell Regulator Co., Industrial Div.

Dust Collector **709**

Fly ash precipitator consisting of primary concentrator and secondary separator is featured in 12-page bulletin 1628. Illustrated explanation of principles of operation together with engineering specifications and construction details are presented. American Blower Corp.

Research **710**

Air pollution is one of the many fields served by the well-known Battelle organization. Illustrated 36-page brochure conducts you on a tour through their laboratories, introduces you to the personnel, and discusses in brief the fields of research and arrangements with sponsors. Battelle Memorial Institute.

Dust Collectors **711**

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrestor types are the subject of 32-page bulletin. Air conditioning, ventilating, conveying, drying, and cooling are also presented. Case histories of numerous industrial installations are illustrated. Kirk & Blum Mfg. Co.

Gas Scrubbers **712**

Efficient dust removal of micron and sub-micron dusts by using cyclonic and venturi gas scrubbers is discussed in 8-page bulletin M-102. Descriptions, illustrations and performance data are presented. Chemical Construction Corp.

Cloth Screen Collector **713**

Cloth screen dust collectors are the subject of 28-page illustrated bulletin 909A, entitled "The Control of Industrial Dust". Features chapters on how it works, types of systems available, capacities and specifications along with application data and case histories. Pangborn Corp.

Wet Collectors **714**

Multi-wash wet method dust collectors are described and illustrated in 20-page bulletin 510. Design features and typical installations are included. Settling and dewatering equipment, and sludge pumps are also featured. List of available bulletins covering specific applications and equipment is also included. Claude B. Schneible Co.

Centrifugal Collector **715**

Duclone, centrifugal type collector, is the subject of 12-page catalog DC-49. Efficiency, multiple arrangement, testing equipment, applications and capacities are discussed and illustrated. Layouts for specific installations are presented. The Ducon Co.

Dust Collectors **716**

Series of four folders describe cyclone type collector and portable, standard, and automatic bag type dust arrestors. Also includes 32-page catalog describing exhaust fans for dust collecting and air handling. Northern Blower Co.

Draft Inducers **717**

Draft inducers help to reduce or eliminate smoke and obnoxious gas, according to 4-page folder 1-51. Unit containing welded steel axial-flow fan is described and illustrated. Selection table and general dimensions are included. L. J. Wing Mfg. Co.

Collectors & Hoods **718**

Bell-Spray wet dust collectors and Dust-Sucker foundry ventilating hoods are featured in 40-page booklet 99. Control of industrial dusts is discussed and principles of operation and design features are presented. Six pages of technical data concerning air flow are also presented. Bartlett-Snow Co..

Bag-type Collector **719**

Dust is filtered through a cylindrical bag of hard wool felt in the Mickro-Collector. Principles of operation, efficiency, dependability, applications, construction and specifications are discussed and illustrated in 12-page bulletin. Pulverizing Machinery Corp.

Bag-type Collector **720**

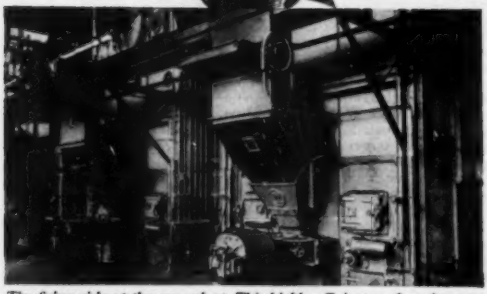
Aeroturn is an automatic-cleaning bag-type collector using pressed wool felt as the filter medium. Advantages, features of construction, and typical installations are illustrated and described in 16-page bulletin. Turner and Haws Engineering Co., Inc.

"Orchids to Oppenheimer!

THAT NEW COAL HEATING SYSTEM HE DESIGNED SAVED $14,000 THE FIRST YEAR!"

says Carl R. Beckert, President, Thomas Young Orchids, Inc., Bound Brook, N. J.

"We're the largest orchid-growers in the world—Phil Oppenheimer is our consulting engineer. Had to have the most *dependable* heat we could find—steady, quickly available—to protect two million dollars' worth of orchid plants. Our new coal-fired plant gives us that kind of heat—in addition saved us $14,000 the first year! We've discovered that with modern equipment coal is as clean and automatic as any other fuel—and to do the job with oil would have meant an overall cost of 16% more! More than that, we can't take a chance on uncertain winter fuel deliveries. With *bituminous* coal we can store a year's fuel supply right on the ground."



The firing aisle at the new plant. This highly efficient coal equipment cut the company's fuel costs by 23%—is so completely automatic that it saved $6,000 the first year on labor costs, too!

This 300-ton silo that Young installed does away with former handling and shovelling costs. Coal is fed from the silo by a screw conveyor to each boiler's stoker-hopper—the coal is weighed on its trip.

- Use coal now? Get ALL coal's economy with highly efficient modern equipment. Building a new power plant? Find out how much more economical, efficient a job *bituminous* coal can do. Call in a competent consulting engineer. He can show you the modern coal-handling and combustion installations that will save most while meeting your particular needs. Remember you can count on *bituminous* coal! Of America's total fuel reserve—92% is coal! Even today oil is *imported*—while America can and does *export* coal! Ample coal reserves plus the outstanding efficiency of America's mining companies give coal users *the greatest possible assurance of a dependable fuel supply at stable prices.*

If you're running your own steam plant, here are just a few down-to-earth facts you can't afford to ignore!

COAL in most places is today's most economical fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

FOR HIGH EFFICIENCY *FOR LOW COST*

YOU CAN COUNT ON COAL!

3 Ways to Step up Plant Operation

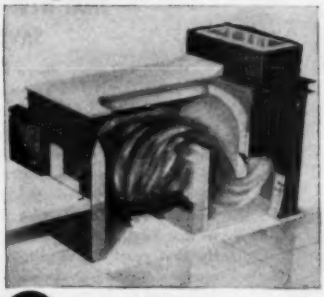
1 Plibrico linings to cut refractory cost

Plibrico monolithic construction is the final answer to your fire brick problem. Plibrico is more durable and economical than laid-up fire brick—saves you money, time, and trouble.

Plibrico eliminates the usual joints. It comes in moist, plastic form, is pounded into place with a steel hammer or air rammer, then trimmed smooth and baked out by the fire. It forms a solid, one-piece lining like a lining carved out of one huge fire brick. It's ideal for door arches and burner openings, conforms to any required shape, eliminates special tile.

Plibrico construction is versatile. It is suitable for all types of boilers from the largest steam generator to the smallest heating boiler. For severe service, it is readily sectionally-supported and/or air-cooled.

Behind the broad Plibrico line of plastic and castable refractories is the nation-wide installation and boiler setting service available through your local Plibrico Sales & Service distributor. Coupon brings new catalog covering Plibrico products for boiler settings and furnace enclosures.



2 Plibrico Incinerators to solve waste-burning problems

Burning rubbish in open fires is outlawed by ordinance in many cities — always outlawed by all the rules of good plant housekeeping. An open fire is a fire hazard and smoke nuisance which industry cannot tolerate today.

The Plibrico Standard Rubbish Destructor, shown above, is the ideal incinerator for the disposal of industrial and institutional waste such as paper, cartons, floor sweepings, rags, wood scrap, etc. It will also burn moderate amounts of wet refuse if mixed with the dry material.

Plicast monolithic lining means long refractory life; insulated steel casing and air-cooled stack prevent exterior deterioration; efficient furnace design provides turbulence and long flame travel essential to complete, smokeless combustion. Erected in four standard sizes with capacities of 500, 1200, 2200 and 3500 lbs. per hour.

For lesser requirements, the Plibrico Portable Incinerator is made in four sizes from 135 to 450 lbs. per hour. It's a steel-cased unit ready to install and operate. Check coupon for Incinerator Catalog covering type and size for every need.

3 PliOjet systems to stop that smoke

The "before and after" pictures are just one set of many which have been taken all over the country to show the remarkable results obtained with our PliOjet system of smoke abatement.

PliOjet eliminates smoke by introducing high-velocity air over the fire where it is needed to provide the oxygen and turbulence necessary for complete combustion and smokeless operation. Gives brighter fires, higher furnace temperatures, cleaner flues; increases combustion efficiency, saves fuel, gives more steam per pound of fuel.

Manufactured in ten standard sizes ranging in firing rate from 96 to 3900 lbs. of coal per hour. Every installation is individually engineered to meet specific requirements. Blower characteristics, jet nozzle orifices, spacing, and penetration lengths are all exactly determined. Manual, automatic, or electronic control.

Installation is expertly handled by your local Plibrico Sales & Service distributor. Check coupon for the PliOjet bulletin and combustion survey sheet.

PLIBRICO *Jointless* **FIREBRICK**

PLIBRICO *Industrial* **Incinerators**

PliOjet System for Smoke Abatement

PLIBRICO JOINTLESS FIREBRICK COMPANY
1802 Kingsbury St., Chicago 14, Ill.

Coupon brings catalogs

These new catalogs are just off the press. Check those which will step up your plant performance.

TO PLIBRICO JOINTLESS FIREBRICK CO.
1802 KINGSBURY ST., CHICAGO 14, ILL. IP

Please send free catalogs as checked:

- ☐ Plibrico Refractory Products for Boiler Settings & Furnace Enclosures
- ☐ Plibrico Incinerators
- ☐ PliOjet System for Smoke Abatement

FIRM_____

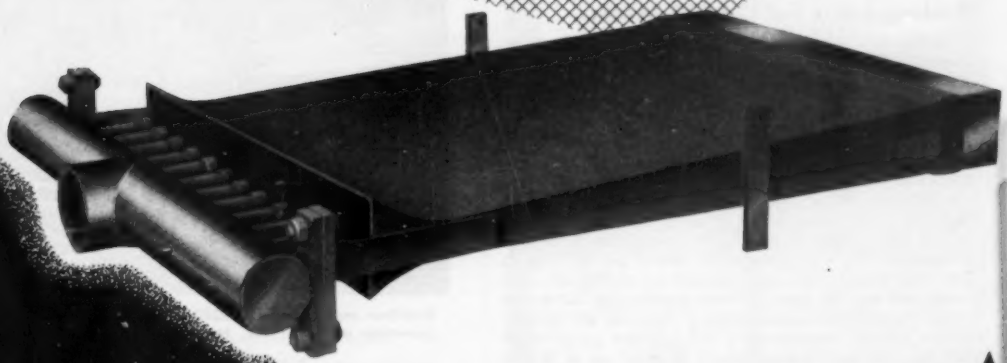
ADDRESS_____

NAME_____ TITLE_____

WE HAVE_____ BOILERS_____ H.P._____ TYPE

APPROX. AMOUNT OF REFUSE TO BE CONSUMED_____ LBS. PER HR.

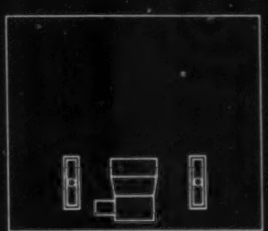
Another WEBSTER FIRST



WEBSTER RECTILINEAR Gas Burner

For gas firing ~~over~~ beside stokers and oil burners

FIRING IN A VERTICAL PLANE ON EACH SIDE OF A ROTARY CUP OIL BURNER



FIRING IN A VERTICAL PLANE ON EACH SIDE OF A STOKER HOPPER

Now available after almost three years of operating tests and installations having capacity of 1,242,000,000 Btu/hr. at 10 psig.

This unique application of the *Venturi* principle has resulted in a high input burner that can be installed through *very* narrow rectangular furnace openings.

It is recommended for inter-tube firing; firing in a horizontal plane through small openings over coal grates; firing in a vertical plane on either side or on a horizontal plane over a stoker or oil burner; and also for use in all types drying kilns.

It is small in size, and light in weight, with excellent turn-down without flash back; stable flame retention even at high inputs—low noise level.

Write for Series B22 Bulletins.

The WEBSTER ENGINEERING COMPANY

TULSA, OKLAHOMA

Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio

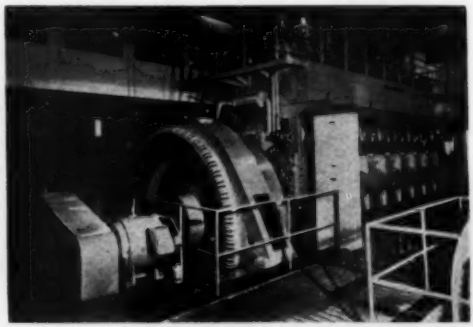
Spot news

Short, "boiled-down" paragraphs on the most interesting recent events and developments in American industrial plants.

Engine Operating on Natural Gas Produces Kwh at Fuel Cost of 2.74 Mills

In less than five years, the City of Estherville, Iowa has added 6,216 hp to its municipal power plant, bringing total capacity to 11,391 hp. The additions have been planned to provide maximum economy with gas-burning engines and still maintain a plant that can operate efficiently on oil if gas supplies are curtailed.

The latest engine is a 3200 hp Nordberg Duafuel engine operating on natural gas. It is a two-cycle, trunk piston, mechanical-injection engine of eight cylinders, 21½ in. bore and 29 in. stroke, which develops its rated horsepower at 225 rpm. Driven by the engine is a separate three-stage compressor which compresses the natural gas to 1175 lb. The high-pressure gas goes through an after-cooler to a header and into the cylinders through admission valves controlled by hydraulic actuator pumps. Mounted on the compressor unit is a separate set of fuel injection pumps which deliver a precisely-metered charge of pilot oil to initiate combustion of the gas. The engine can be canverted readily to full oil operation with the regular large-volume injection pumps handling the fuel.



Dual-fuel engine, rated at 3200 hp, provides economical operation at Estherville, Iowa municipal power plant

Operating as an oil engine for 256 hr in its first month of service, the new engine produced 374,500 kwh, averaging 13.64 kwh per gal of oil at approximately 60 per cent load. Switched over to gas, the unit ran 3,911 hr in the next seven months, generating 6,416,800 kwh. Gas consumed averaged 11.47 cu ft per kwh and pilot oil averaged .0042 gal per kwh. With gas at 20 cents per 1000 cu ft and oil at 11 cents a gal, the cost per kwh was 2.28 mills for gas and 0.46 mills for oil, making a total fuel cost of 2.74 mills.

The Cover—Pumping Station at L. A.

• This month's cover illustration, taken in Los Angeles' Harbor Steam Plant located at Wilmington, Calif., is a partial view of one of three identical pumping stations each comprised of six horizontal split-casing centrifugal pumps. Although only two pumps are shown, all six at each station circulate water through heat exchangers to reduce the temperature of hydrogen utilized in cooling 75,000 kw generators. In the plant there are two additional pumping stations, each serving generators of 65,000 kw capacity.

The two pumps in the cover illustration are of 5 x 6 in. size with 13 in. impellers. Each is rated at 900 gpm against a total dynamic head of 100 ft; motor speed is 1750 rpm. The control panel in the background is a remote station directly controlled by an operator at a platform 40 ft above the pumps. High and low pressure and temperature alarms are panel mounted at the platform to signal the operator should adverse conditions occur at the pumps or heat exchangers. All of the pumps were built by Peerless Pump Div., Food Machinery and Chemical Corp.

Harbor Steam Plant, which serves metropolitan Los Angeles in conjunction with other city operated power stations, is considered one of the finest and most efficient in the west. It has a total electrical generating capacity of 355,000 kw.

Plant Location Based on Weather Called Factor in Air Pollution Prevention

Plant location based on the weather was advocated as a major step toward solving the problem of industrial air pollution. The cost of a study of the "air pollution potential" of a possible plant site represents but a tiny fraction of the total investment in the plant, and can pay large dividends in good will, efficiency and even labor relations, Dr. Frederick G. Sawyer, administrator, air and water research, Stanford Research Institute, Stanford, Calif., declared at the 72nd annual meeting of ASME.

The time has come, Dr. Sawyer stated, when in addition to the usual considerations, proximity to raw materials, cheap and usable water, transportation facilities, and labor, the weather must also be considered as an important factor in plant location. He said this new factor will grow in importance proportionally to the inevitable increasing severity of air pollution control ordinances throughout the country. A company can design and build a plant which will not be an air pollution hazard if it is armed with weather data from which to evaluate possible plant sites.

Dr. Sawyer described a typical study of several possible plant locations on the basis of potential air pollution, which was made for a large company. He said the wind was examined for direction, velocity, seasonal variations, diurnal changes, and seasonal change of diurnal patterns. Atmos-

pheric stability (inversion) was studied. Geography was considered. This permitted re-examination of wind patterns in relation to topography for explanation of them.

General climatic conditions (storm pattern and frequency) were examined. A location which is subject to frequent storms is inimical with respect to air pollution nuisance or damage. The general activity and attitude of the area were studied. Answers were found for the following questions: What was the history of air pollution in the area? Proximity to farms, schools, towns? Effects of effluents on crops? Is the trend of human activity away or toward farming or industry? Trend to home developments?

The weather data were assembled to construct a pattern of possible pollutant concentrations downwind from the industrial plant under all possible combinations of season and day versus night. The possible concentration of pollutants in nearby towns was calculated. A table of crops was prepared showing their order of sensitivity to specific pollutants the industrial plant would emit. Vegetation in the area was analyzed for some of these pollutants. This established the concentrations existing before the factor would add to the atmospheric load.

Data showing pollution levels prior to plant construction can be useful in helping determine responsibility for possible future damage. On the basis of these numerous considerations a conclusion was reached regarding the best location from the standpoint of air pollution potential.

Penn Water "Mines" River Coal for Anthracite-fired Steam Generating Plant

The world's largest anthracite-fired steam generator is now being manufactured by the Foster Wheeler Corporation at its Carteret, N. J. and Danville, N. Y. plants, and will be erected at the Holtwood, Pa. hydroelectric and steam generating plant of the Pennsylvania Water & Power Company.

Bituminous coal or oil are the fuels used in the vast majority of the nation's steam generating plants with a comparative few using anthracite for their boilers. Penn Water's operation is unique. The Susquehanna River, on

(Continued on page 116)

DRY ICE USED TO SHRINK 2200 LB MOTOR SHAFT

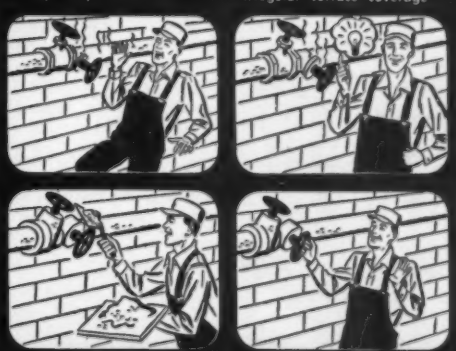
Engineers at General Electric remove motor shaft from dry ice. Shaft was imbedded in the ice overnight in order to shrink it enough to fit into tight armature. At room temperature, the shaft expanded approximately .006 in.

BH therm-enomics* presents No.1 CEMENT

The All Purpose Black Rockwool Insulation

This Baldwin-Hill feature rates top billing for efficiency, coverage, and ease of application. Consider the following qualities of No. 1 Cement for a leading role in *your* heat-control picture:

- Pre-mixed . . . add water and trowel on
- Rust retarding high adhesion
- Fully effective to 1800°F
- Reclaimable below 1200°F
- Dry coverage approx. 50 sq. ft. per 100 lbs.
- Irregular surface coverage



Let B-H help you reduce heat loss . . . by recommending the type of insulation best suited to *your* problems of heat control. A *complete* line of *Black* Rockwool materials—cements, blanket, block, etc.—is the basis for Baldwin-Hill's THERM-ENOMICS® SERVICE.

*Economics of Engineered Heat Control

Baldwin-Hill

IF IT'S TOO HOT TO TOUCH IT NEEDS INSULATION

Black Rockwool

clip this coupon to your signed letterhead

SEND ME COMPLETE INFORMATION ON:

- ☐ Mono-Block —for temperatures to 1700°F
- ☐ Blankets —metal reinforced, large-area coverage to 1300°F
- ☐ No. 1 Cement —plastic insulation, to 1800°F
- ☐ Powerhouse Cement —high-adhesion finishing to 1700°F

BALDWIN-HILL CO., 834 BRUNO AVE., TRENTON, N. J.

D-8232

DUCON HIGH EFFICIENCY DUCLONE COLLECTORS *SOLVE*

DUST CONTROL

PROBLEMS IN ALL INDUSTRIES

Whether used for dust recovery to reclaim valuable by-products or controlling dust to prevent air pollution, DUCLONES are guaranteed to give satisfactory and economical service. Expertly engineered, scientifically designed and backed by a quarter century of specialized experience in building dust collecting equipment.

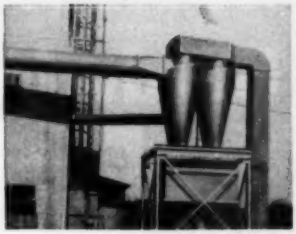
Because different in design, the DUCLONE embodies many constructional and operational advantages, only several of which include: cyclone type separators built with non-turbulent gas inlets to insure a smooth flow, without destructive eddy currents. Inlet control and vortex shield result in highest performance efficiency since resistance to centrifugal action is held to a minimum.

Multiple Unit DUCLONE

Each DUCLONE Collector is custom-built, in single or multiple units, to your requirements, with proper balance of shape, size and vortex shield in relation to air velocity.

A DUCON engineer will gladly confer with you regarding your particular dust problem

Write for Catalog DC49-11.



Typical Installation

DUCON Products: DUCLONE Collectors—Centrifugal Wash Collectors —Filters.

The DUCON Co.
MINEOLA, N. Y.

Spot news

(Continued from page 115)

which its hydro plant is located, flows through the Pennsylvania anthracite fields 150 miles above Holtwood. Over the years this stream has brought millions of tons of coal, in the form of tiny particles about the size of a pin head, downstream. This coal is "mined" from the bottom of Lake Aldred, behind the Holtwood dam and Lake Clarke, behind the Safe Harbor Water Power Corporation's dam eight miles upstream from Holtwood. The silt deposits—part sand and loam and part fine coal particles—are recovered and the coal separated from the waste.

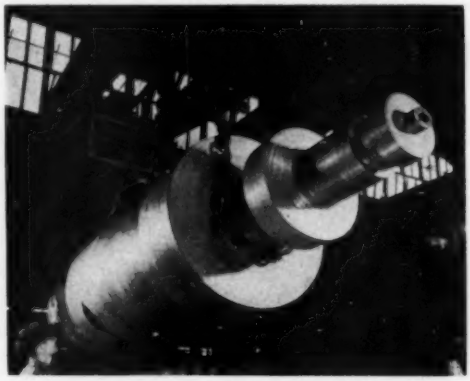
The new unit comprises a "furnace" which, when erected, will stand 100 ft high with approximately 96,000 cu ft of furnace space. Each hour 46.6 ton of the "river coal" will be burned in this furnace.

As a part of the coal preparation, Foster Wheeler will install four ball mill pulverizers designed to pulverize 56 ton of the "river coal" every hour. Each is 10 ft in dia and driven by a 600 hp motor. This talc-like coal is blown into the furnace where it is ignited and mixed with pre-heated air. The hot gases pass over 22.4 miles of tubes to produce 700,000 lb of steam per hr. This steam, at 945 psi and 905 F will turn the generator at 3600 rpm. Although the turbine generator will have an official rating of 66,000 kw, it is expected that ultimate capacity will be closer to 75,000 kw. A combination of electro-static and mechanical fly ash collectors will trap some 143 ton of fly ash per day.

Traveling Show Teaches Industrial Battery Maintenance

The Industrial Battery Division of Gould National Batteries, Inc., is producing a one-hour-long Broadway type show which will tour large industrial cities early in 1952.

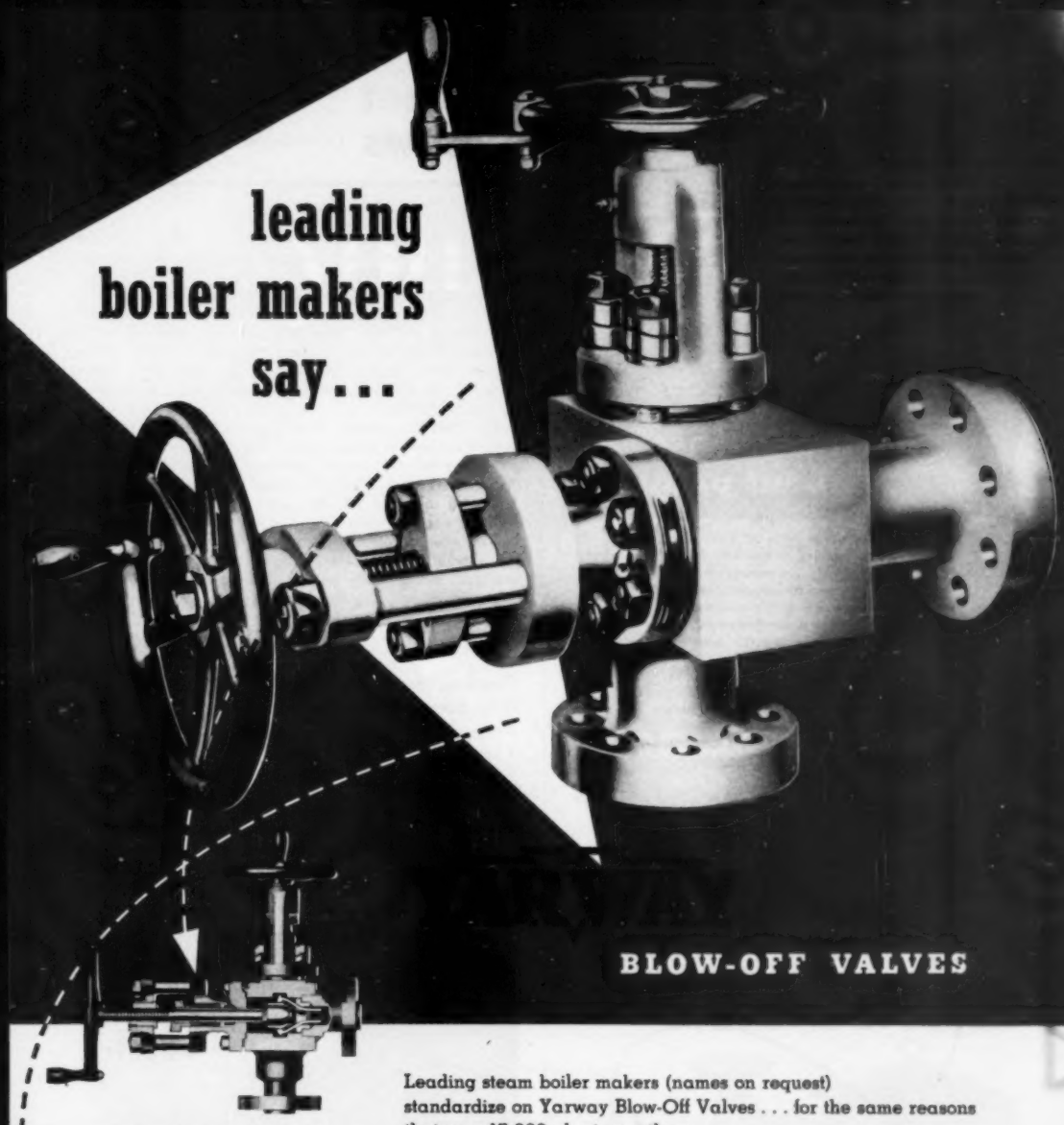
(Continued on page 118)



120,000 KW GENERATOR WILL USE 18 TON ROTOR

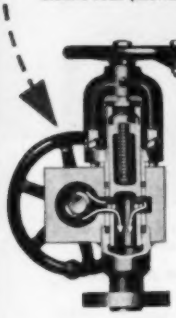
Being moved for further heat treatment is rough-machined rotor for the first of two Allis-Chalmers 120,000 kw, 3600/1800 rpm steam turbine generator units for the Wisconsin Electric Power Company's new Oak Creek power plant

leading boiler makers say...



BLOW-OFF VALVES

Yarway Unit Tandem Valve sectioned through stellite-seat (blowing) valve. Open position.



Yarway Unit Tandem Valve sectioned through seatless (sealing) valve. Open position.

Leading steam boiler makers (names on request) standardize on Yarway Blow-Off Valves . . . for the same reasons that over 15,000 plants use them:

- UNIQUE DESIGN
- MODERN METALLURGY
- RUGGED CONSTRUCTION

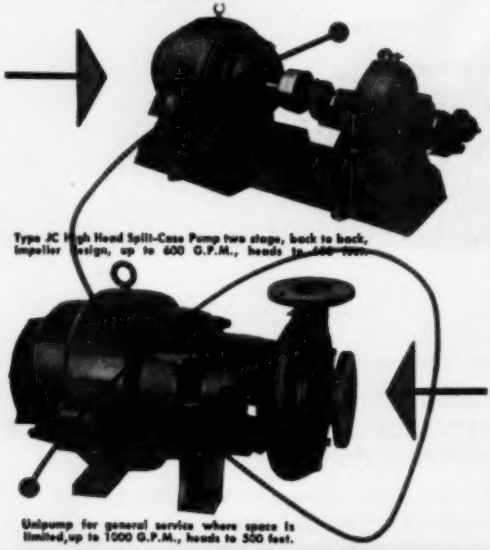
} TROUBLE-FREE SERVICE

How these features will help your boiler operation is clearly explained in Yarway Blow-Off Valve Bulletins. Write for one, telling us your operating pressures.

YARNALL-WARING COMPANY 109 Mermaid Ave., Philadelphia 18, Pa.
Branch Offices in Principal Cities

BLOW-DOWN TROUBLES...KEEP BOILERS ON THE GO

Extensive experience with all kinds of pumping applications makes any advice from a **WEINMAN** representative sound advice. He is backed by an organization which devotes its entire skill to the continuous improvement of one product—pumps. His head and his briefcase are crammed with ideas and engineering data on how liquids can be handled most effectively. This data plus common sense gained through experience can be applied to your problem to get the results you need. Plan to talk over your pump problems with a specialist—just write, wire or phone **WEINMAN**, Career Men in Pumps.



Type JC High Head Split-Case Pump two stage, back to back, impeller design, up to 600 G.P.M., heads to 400 feet.

Unipump for general service where space is limited, up to 1000 G.P.M., heads to 500 feet.

Built by Centrifugal Specialists

The **Pump Mfg. Co.**

286 SPRUCE ST. • COLUMBUS 8 • OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

Spot news

(Continued from page 116)

The review, entitled "Gould Nuggets of 1952", comprises a series of entertaining Carnival acts explaining the new Plus Performance Plan.

The underlying reason for the program is to teach industry how to get maximum capacity from its equipment and extend its life. This objective, of tremendous importance at all times, has an even greater impetus today because of the serious shortages of lead and other battery materials. In addition, industry is demanding a much larger volume of batteries.

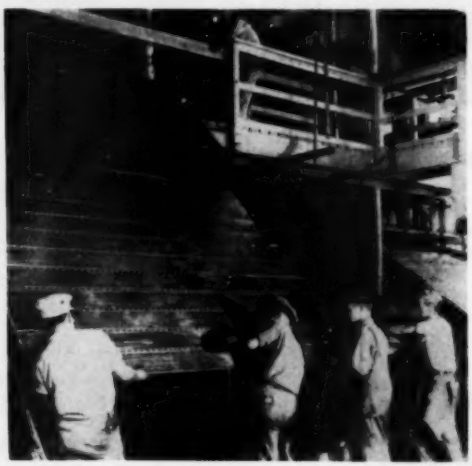
The Plus Performance Plan comprises a library of information on how to select, charge and handle, maintain, and determine the condition of industrial storage batteries. The material is available, free, to industrial battery users.

Invited to attend will be plant superintendents, supervisory personnel, materials handling engineers, maintenance men, purchasing agents, battery-room supervisors, and others concerned with the care and maintenance of industrial storage batteries and equipment operated by batteries. Invitations may be obtained from Gould's Industrial Division field offices.

Stainless Steel Conveyer Belts Help Boost Rubber Output

Conveyer belts of stainless steel have helped boost output of synthetic rubber at the government-owned plant in Port Neches, Texas. The plant is operated by the United States Rubber Company's Naugatuck Chemical Division.

GR-S rubber is manufactured in a complex series of processes which includes copolymerizing butadiene and styrene, coagulating the resulting latex in an acid-brine bath, and then washing and filtering the crude rubber "crumb". As it leaves the filter at this point, the rubber contains ap-



Workmen in synthetic rubber plant assemble flights of stainless steel for corrosion-resistant conveyer belt

(Continued on page 150)

is this

your problem?

Beacon Combustion Service

EASTERN GAS AND FUEL ASSOCIATES

EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH BOSTON CHICAGO CLEVELAND DETROIT NEW YORK
NORFOLK PHILADELPHIA SYRACUSE

For New England: New England Coal & Coke Co., *For Export:* Castner, Curran & Bullitt, Inc.

News
of men and companies

ANNIVERSARIES

Bigelow-Liptak Corp.—Celebrated its 25th birthday by announcing its move to larger and up-to-date general offices at 2550 W. Grand Boulevard, Detroit 8, Mich.

Chicago Metal Hose Corp.—Effective January 1, 1952, on the occasion of its Fiftieth Anniversary, Chicago Metal Hose Corp. became Flexonics Corp. The company is now building its sixth manufacturing plant in Memphis, Tenn.

SOCIETIES

American Institute of Electrical Engineers—Two General Electric authorities in the field of mercury arc power rectification, L. W. Morton and A. Schmidt, Jr., have been named Fellows. W. H. Taylor, regional power manager for the Bureau of Reclamation's hydroelectric power system in the lower Colorado River basin, also has been awarded a Fellowship.

American Society of Mechanical Engineers—R. J. S. Pigott, director of the engineering div of Gulf Research and Development Co., a subsidiary of Gulf Oil Corp., has been elected president for 1952. Regional vice presidents elected are: W. F. Thompson, chief mechanical engineer, Westcott & Mapes, Inc., New Haven, Conn.; E. H. Hanhart, consulting mechanical engineer, Baltimore, Md.; E. S. Theiss, asst chief engineer, Davey Compressor Co., Kent, Ohio, and S. H. Graf, (reelection), director, Engineering Experimental Station, Oregon State College, Corvallis, Ore. Elected directors-at-large were A. C. Pasini, supt production dept, The Detroit Edison Co., Detroit, Mich., and P. B. Eaton, head of the mechanical engineering dept, Lafayette College, Easton, Penna.

HONORS

American Society of Mechanical Engineers.—The society's highest award, the ASME Medal, was presented at the 72nd annual meeting to G. B. Warren, general mgr, Turbine Div., General Electric Co. for "leadership in the science and art of turbine design."

Three of the most coveted engineering honors of this country also were awarded. The recipients were W. L. Batt, minister in charge of the Economic Cooperation Administration Mission to the United Kingdom, who received the Hoover Medal; E. G. Bailey, v-p of the Babcock and Wilcox Co., awarded the John Fritz Medal, and T. R. Jones, president of Daystrom, Inc., winner of the Henry Laurence Gantt Medal.

Mississippi Power & Light Co.—Received the Ebasco Gold Award for having an "injury index" 65.72% below the national average for the electric utility industry during the past year.

APPOINTMENTS

Gifford-Wood Co.—W. G. Engler, sales engineer for nearly twenty-five years, has assumed the duties of general sales mgr. The position has been vacant since the death of W. E. Herb.

W. G. Engler G. H. Sherrard

Owens-Corning Fiberglas Corp.—G. H. Sherrard, for the past two years mgr of wire and cable sales, is appointed mgr of the electrical textile sales div.

SALES OFFICES

Atlas Chain & Mfg. Co.—New office in New York is headed by O. J. R. Troup, Jr., and located at 250 West 57th Street.

Black, Sivalls & Bryson, Inc.—L. M. Petrie will be in charge of the recently opened Wichita Falls, Texas, office.

The Hydraulic Press Mfg. Co.—Chicago office now located at 3058 Peterson Bldg., Peterson Ave. Continuing in charge is D. C. Youngblood.

International Rectifier Corp.—New factory building, located at 1521 East Grand Ave., El Segundo, Calif., will house genl sales and administrative offices. The plant now occupied at 6809 S. Victoria Ave., Los Angeles, will be maintained for research and development.

Minneapolis-Honeywell Regulator Co.—New district office was opened at Harrisburg, Pa., in the Kline Village development. W. J. Brosch and J. Caylor will handle sales for the Brown Instruments Div. J. Hopkins will handle commercial, and D. Schmick heating controls div sales.

Nordberg Manufacturing Co.—In establishing Seattle, Wash., branch office located at 2520 Westlake Ave., N., Nordberg acquired the entire sales and service facilities of the former Al-Pac Engine & Equipment Co. C. S. Harris, former mgr of Al-Pac, will head the new office.

Republic Flow Meters Co.—Houston factory branch office under the direction of G. H. (Jack) Woodard is located at 2426 W. Holcombe Blvd. Other recent additions to the field engineering staff include: New factory branch office at 1002 Second Ave., Seattle, Wash., headed by H. Weber. St. Louis district office was moved to larger quarters at 13 So. Meramec St., Clayton 5, Mo., where W. G. Baker is in charge. Philadelphia district office has been expanded and relocated at 308 Suburban Square Bldg. in Ardmore, Pa. L. C. Walter continues as district manager. Syracuse branch office was recently located at 317 State Tower Bldg. W. J. Angus is district engineer. Buffalo branch office, located in the Prudential Bldg., has lately been placed in charge of C. T. Duffy.

Warren Steam Pump Co., Inc.—Announces that all business formerly transacted through the office of Parkman A. Collins Co., 75 Federal St., Boston, Mass., will be handled by a new district office located at 6 Leonard St., Belmont, Mass. P. A. Collins has been appointed district mgr in charge and F. W. Amadon, Jr., will be a direct representative. Also, P. J. Murdock, Jr., will continue to represent Warren in northern New England.

NEW REPRESENTATIVES

Exhibit Supply Co.—Electro-Snap Div. announces the appointment of George W. Ledbetter as West Coast representative. He will make his headquarters at the Electro-Snap branch office, 15117 Ventura Blvd., Sherman Oaks, Calif.

Flexrock Co.—The Mechanical Rod Packing and Building Maintenance Div. announce the appointment of Hinds & Associates, Inc. of Kansas City, Mo. as

(Continued on page 122)

SCHOLARSHIP PROGRAM ANNOUNCED

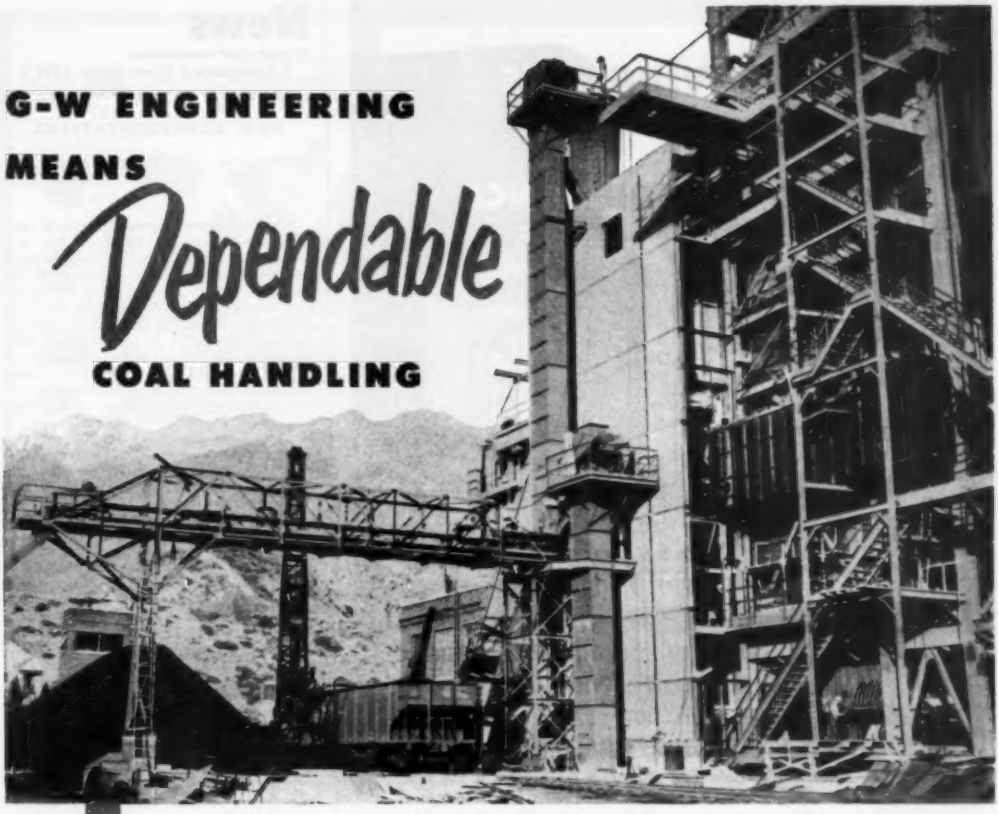
As a practical means of encouraging young men to secure training to prepare themselves for industrial careers, 10 annual scholarships have been offered by Utica Drop Forge & Tool Corp.

The scholarships, covering residence and subsistence at the State University of New York, provide for two school years of training in the university's Department of Mechanical Technology which is part of the New York State Institute of Applied Arts and Sciences. In addition, each student is expected to work in a manufacturing plant during the summer months to supplement his studies by practical on-the-job training.

In order to be eligible for the Utica scholarships, young men must have completed high school successfully. Selection is on a competitive basis as it is hoped the graduates will be individuals who can enter industry in jobs of considerable responsibility.

Awards of the 10 scholarships to outstanding students at the university have already been made for the current school year. In addition, two similar awards have been made to employees of the corporation.

G-W ENGINEERING MEANS *Dependable* COAL HANDLING



The Gifford-Wood coal handling system at the Orem steam electric station of Utah Power & Light Company is designed to handle run-of-mine bituminous coal at 100 tons per hour from dual track hoppers to ground storage, or to overhead storage bins for automatic delivery to boilers. Coal handling is automatic . . . economical . . . completely dependable. The installation, protected by electrical interlocks, is a perfect example of the rugged design and flexibility that can be built into the operation of a well designed power plant.

This complete coal preparation and handling system is but one of the many solutions to dependable low cost coal handling . . . Solutions designed by G-W engineers . . . based upon over 135 years of experience accumulated by G-W in the methods of design, engineering and installation of all types of materials handling systems. Bulletin No. 300 contains the complete story. Send for your copy now, it may well lead to lowered costs tomorrow.

GIFFORD-WOOD CO.

Since 1814
HUDSON, NEW YORK

NEW YORK 17, N. Y. — 420 Lexington Ave.
ST. LOUIS 1, MO. — Railway Exchange Bldg.
CHICAGO 6, ILL. — 565 W. Washington St.

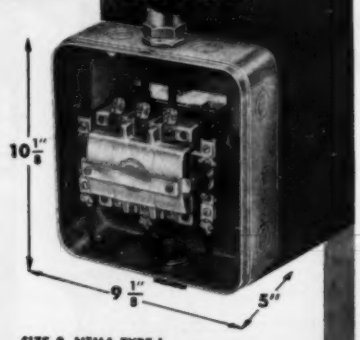
7633

When You Think of Materials Handling . . . Think of Gifford-Wood

SPACE-SAVING SIZE
PLUS
ADDED PERFORMANCE

ARROW AH HART

TYPE "RA"
MAGNETIC
STARTERS



SIZE 2, NEMA TYPE I,
Available sizes 0-1-2-3-4 in NEMA
Type I, IV, V, VII, and IX Enclosures

- ½ THE SIZE OF CONVENTIONAL STARTERS
- MORE DEPENDABLE SERVICE
- GREATER PROTECTION
- YEARS LONGER SERVICE

The "RA", Right Angle, balanced operating mechanism is the first real advance in starter design since the introduction of the original solenoid type. This revolutionary new concept makes it possible for Arrow-Hart to build added performance into starters just ½ the size of outmoded models. The time-tested bellcrank principle is utilized to produce a mechanical advantage which makes it possible for a small, compact magnet to outperform the old fashioned direct-action type. Precision alignment of the rugged, heavy duty contacts is made with a stronger, more positive action. The alkyd base and hood are designed for superior arc control. To safeguard against motor burnout and other damage, every "RA" starter is equipped with overload protective relays which trip under adverse current conditions.

Whatever your starter requirements, you'll find the right Arrow-Hart "RA" starter to do the job better.

HERE'S IMPORTANT INFORMATION—SEND TODAY

AH
THE ARROW-HART & HEGEMAN ELECTRIC CO.
INDUSTRIAL CONTROL DIVISION
1201 HAWTHORN ST., HARTFORD 6, CONN.

Please send me FREE illustrated Engineering Data Bulletins featuring:
☐ "RA" Line ☐ Explosionproof Motor Starters ☐ Multi-Speed & Reversing Starters

NAME_____
COMPANY_____
POSITION_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

News

of men and companies

(Continued from page 120)

NEW REPRESENTATIVES

representatives in the states of Kan., Neb., Okla., Ark., and western Missouri.

Manufacturers' Agents National Association—Local chapters of the association will be launched in principal cities with simultaneous meetings to be held on January 17, according to an announcement by A. B. Smedley, MANA president. Each chapter will operate as an individual unit, in cooperation with the national, to serve the interests of local groups, and will conduct meetings to discuss matters of common interest to manufacturers' agents and their principals.

Perfex Corp.—R. B. Dunning, Bangor, have been appointed distributors for the Heating Controls Div. for northwestern Maine.

Sterling Electric Motors, Inc.—Appointment of the following additional distributors was announced. Allied Bearings Supply Co., 822 South Boulder, Tulsa 5, Okla.; Berry Electric Co., 301 So. 3rd St. Walla Walla, Wash.; Alabama Bearings Co. Inc., 7 Railroad St., Montgomery, Ala.; Stanley Elec. Motor Co. 1520 E. Miner Ave., Stockton 5, Calif.; Roy A. Berentz Co. Inc., 1400 Carr, P.O. Box 564, Houston 1, Tex.

EXPANSIONS

The Babcock & Wilcox Co.—The Babcock & Wilcox Tube Co., a wholly owned subsidiary, was dissolved, effective at close of business Dec. 31. The tube company's business and assets were absorbed by, and it will be operated as, one of the divisions of The Babcock & Wilcox Co. thereafter, according to an announcement.

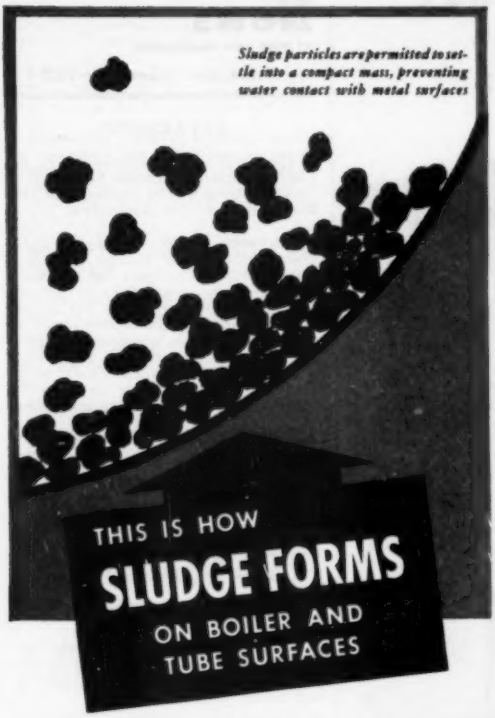
Baldwin-Hill Co.—Has acquired the Rockdale Insulation plant near Housatonic, Mass. Purchase was made from the Eagle-Picher Co., Cincinnati, Ohio.

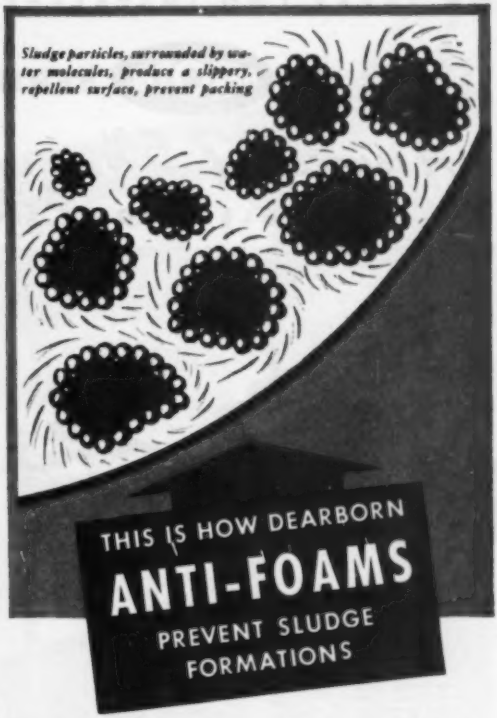
Diamond Alkali Co.—Financing is being arranged for a new expansion program designed to broaden operations in organic chemicals, particularly chlorine-based plastics, solvents and insecticides. Plants at Painesville, Ohio, and Houston, Tex., will share in the expansion. It calls for construction of plants for the production of vinyl resins and improved insecticides at Huston, and perchlorethylene at Painesville, together with the necessary supporting facilities for chlorine production.

The Dow Chemical Co.—Opened a Los Angeles Harbor Terminal for storage of 50 per cent concentrate caustic soda solution.

Association of Bearing Specialists—New trade organization has been incorporated under the laws of the State

(Continued on page 124)


Sludge particles are permitted to settle into a compact mass, preventing water contact with metal surfaces
THIS IS HOW
SLUDGE FORMS
ON BOILER AND
TUBE SURFACES


Sludge particles, surrounded by water molecules, produce a slippery, repellent surface, prevent packing
THIS IS HOW DEARBORN
ANTI-FOAMS
PREVENT SLUDGE
FORMATIONS

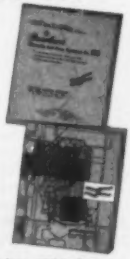
DEARBORN POLYAMIDE ANTI-FOAMS KEEP SOLIDS IN SUSPENSION—PREVENT SLUDGE FORMATIONS

Dearborn Polyamide Anti-Foam No. 659 performs four important functions in boiler water treatment.

1. It makes it easier to maintain a fluid type sludge in boiler water. It prevents growth of the sludge crystals and does not permit them to become attached to the heating surfaces.
2. Anti-Foam No. 659 has protective colloid action which controls the precipitation of carbonate scale. It also prevents "after precipitation" where lime soda water is used for make-up.
3. As an Anti-Foam treatment, No. 659 reduces the number of small bubbles responsible for foaming conditions. Instead, it produces a relatively small number of large bubbles which break harmlessly on the surface.
4. Anti-Foam No. 659 prevents corrosion in feed lines, heaters and internal boiler surfaces caused by dissolved oxygen.

Consult your Dearborn representative for assistance in selecting the boiler water treatment best suited to your needs.

DEARBORN CHEMICAL COMPANY
Merchandise Mart Plaza • Chicago 54, Ill.



TWO VALUABLE BOOKLETS
Write for copies

For information on Dearborn Polyamide Anti-Foams, write for Bulletin No. 5008.

For a complete description of Dearborn Industrial Water Treatment and Engineering Service, write for Bulletin No. 5000. The coupon is for your convenience.

Dearborn Chemical Company
Dept. INP, Merchandise Mart Plaza
Chicago 54, Ill.

Gentlemen: Please send:

( ) Bulletin No. 5008—Dearborn Polyamide Anti-Foams

( ) Bulletin No. 5000—Dearborn Industrial Water Treatment and Engineering Service

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Company.....

Position.....

Address.....

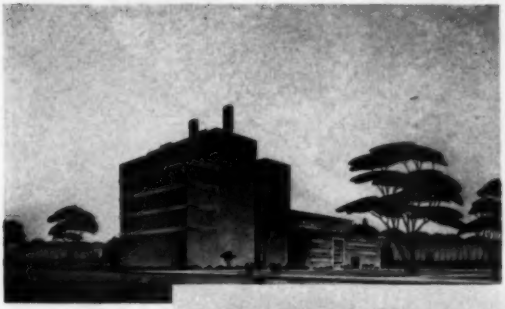
City.....State.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

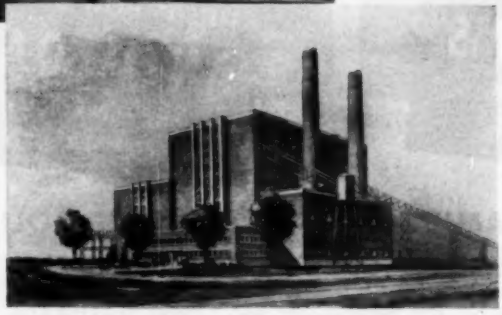
ON THESE TWO INSTALLATIONS

the AEROTEC SERIES

Assures 97.5% FLY ASH COLLECTION *Efficiency*



LEFT: The 264,000 kw (four units) J. Clark Keith Generating Station of The Hydro-Electric Power Commission of Ontario at Windsor, Canada. H. G. Acres & Co., Niagara Falls, Ontario, Consulting Engineers.



RIGHT: The 400,000 kw (four units) Richard L. Hearn Generating Station of The Hydro-Electric Power Commission of Ontario at Toronto, Canada. Stone & Webster Engineering Corp., Boston, Mass., Engineers and Constructors.

Here's on-the-job proof that Aerotec Series Mechanical-Electrical Dust Collectors are used for continuous efficiency. Guaranteed 97.5%, at normal full load the overall efficiency is anticipated as high as 99% at these two Canadian generating stations of The Hydro-Electric Power Commission of Ontario. Aerotec Series Collectors serving each plant combine a design 3RAS Mechanical and an Electrical Precipitator.

In the Mechanical unit, small diameter, permanent molded aluminum tubes provide high efficiency. Exclusive Aerotec pocket type collecting electrodes in the Electrical Precipitator reduce reentrainment of dust in the gas stream, contributing to a sharp improvement in stack appearance. The combined actions of these units assure maximum dust collection efficiency. Many Aerotec Series installations verify that fact.

Your plant can eliminate dust nuisances with Aerotec equipment just as many well-known companies have done. This highly successful performance is a reliable measure of Aerotec ability to solve your dust collection problems. Write our Project Engineers today!

Project Engineers

THE THERMIX CORPORATION

GREENWICH, CONNECTICUT

(*Offices in 38 Principal Cities*)

Canadian Affiliates: T. C. CHOWN, LTD.

Montreal 25, Quebec — Toronto 3, Ontario

THE AEROTEC CORPORATION

GREENWICH, CONN.

News

of men and companies

(Continued from page 122)

EXPANSIONS

of Illinois, it was announced by W. F. Chase, president, Bearing Service Co., who has been named chairman of the board for the new association.

Fairbanks, Morse & Co.—S. Patti Construction Co. of Kansas City, Mo. was awarded a contract for the yard work for new pump plant in Kansas City, Kan. Contracts have not as yet been let for the actual construction of the plant which is scheduled to begin next spring. The new plant will have a machine shop containing 190,000 sq ft of floor space, a foundry with 150,000 sq ft, and an office building containing 20,000 sq ft.

R. E. Moyer, Inc.—Announces the opening of its newly acquired plant and offices at Tenth and Union Streets, Catasauqua, Pa.

Pennsylvania Salt Mfg. Co.—New facilities, including an electrolytic chlorine-caustic soda unit, at an estimated cost of $8 million comprise the second major step in the development of the Calvert City, Ky., works.

Precision Tube Co.—Recently announced its entry into the field of fine drawn, precision low carbon, welded and drawn steel tubing.

South Carolina Electric & Gas Co.—Construction for the first two units of new steam generating plant with an ultimate capacity of 300,000 kw is scheduled to start shortly at a site on the South Carolina side of the Savannah River, four miles south of Augusta, Ga.

Electro Tec Corp.—Announces the opening of a new experimental and development laboratory in Ormond Beach, Fla.

APPOINTMENTS

Air Reduction Co.—J. H. Humberstone was elected a v-p. He was formerly president of the Airco Equipment Mfg. Div. and has been succeeded in that capacity by S. D. Baumer.

Allis-Chalmers Mfg. Co.—E. R. Narum, an application engineer in the substation section of the power dept, has been assigned to the Detroit district office of the general machinery div. C. R. Martin is named in charge of manufacturing, production planning and control and H. F. Banzhaf is now asst to mgr at the Hawley Works.

American District Steam Company, Inc.—L. D. Warner is appointed to the position of v-p in charge of market and product development and promotion.

The American Pulley Co.—Announces the appointment of H. W. Gordon as district mgr in the northwest with headquarters in the Maritime Bldg, 911 Western Ave., Seattle, Wash. Also announces the appointment of S. H.

Hewett as district mgr in the Detroit area. His headquarters is at 1357 Sheridan Ave, Plymouth, Mich.

Ampco Metal, Inc.—Announces the appointment of N. S. Cobleigh as district mgr of the Philadelphia sales div.

Armstrong Cork Co.—Has established a separate felt and fibrous products dept of the Industrial Div. D. P. Paiste, formerly mgr of the district office at Boston, has been named mgr of the new dept.

Bowser, Inc.—New advertising mgr is H. J. Slack.

Cleveland Chain & Mfg. Co.—W. W. Fuller is named purchasing agent.

John Chatillon & Sons—N. W. Mailman has been elected president. A. J.

A. J. Chatillon **N. W. Mailman**

Chatillon, former president, has been elected to the position of chairman of the board.

Conoflow Corp.—J. R. Simpson & Co., Chicago representatives, announces the appointment of a new associate, J. R. Simpson III.

Consolidated Engineering Corp.—Appointment of J. H. Lancor, Jr., as director of the Transducer Div. is announced.

Cullman Wheel Co.—N. B. Weinke, recently sales mgr, has been elected v-p.

Dravo Corp.—The Machinery Div. announced the appointment of L. E. Russell as sales engineer.

Dearborn Chemical Co.—Announced the addition of W. A. Tinsler, Jr., to the company's sales staff.

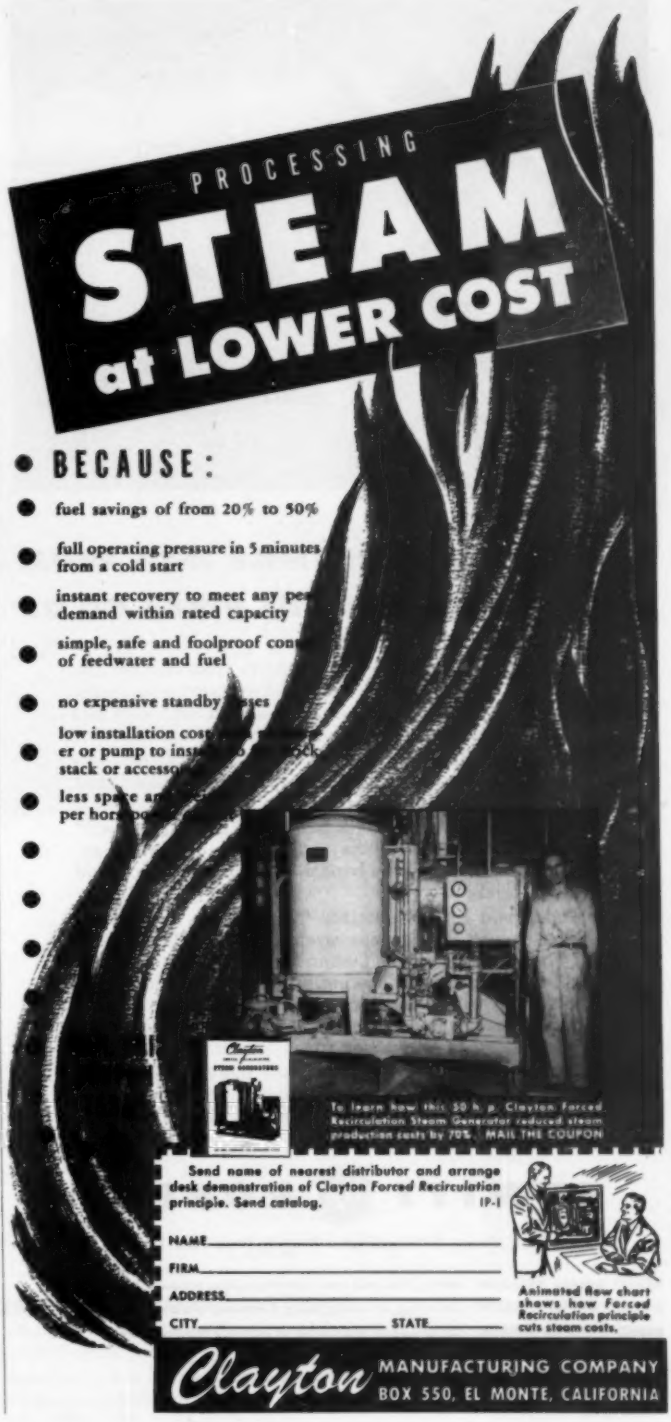
Delta-Star Electric Co.—Appointment of J. C. Hydrick as works mgr was announced.

Electronic Devices, Inc.—F. H. Edelman, formerly chief chemist of International Resistance Co., has been appointed technical director of the Resistor Div.

Feedrail Corp.—Appointment of R. R. Gillen as purchasing agent is announced.

General Controls Co.—J. R. Ferguson is appointed district mgr of the branch office at Denver, Colo., and H. Lindstrom, former Denver branch mgr, assumed a similar position at the Minneapolis branch.

(Continued on page 126)


PROCESSING
STEAM
at LOWER COST
BECAUSE:
fuel savings of from 20% to 50%
full operating pressure in 5 minutes from a cold start
instant recovery to meet any pe demand within rated capacity
simple, safe and foolproof con of feedwater and fuel
no expensive standby ses
low installation cos er or pump to inst stack or access
less spa per hors
To learn how this 20 h. p. Clayton Forced Recirculation Steam Generator reduced steam production costs by 70% . . . MAIL THE COUPON
Send name of nearest distributor and arrange desk demonstration of Clayton Forced Recirculation principle. Send catalog.
IP-1
NAME
FIRM
ADDRESS
CITY
STATE
Animated flow chart shows how Forced Recirculation principle cuts steam costs.
Clayton MANUFACTURING COMPANY
BOX 550, EL MONTE, CALIFORNIA

MILLION-MILE IDEA FROM WATCHING THE BIKES GO BY

From the way bicycle tires resisted the abrasion of cobblestone roads came an invention which is now an essential lifeline of the American industrial economy.

It was in 1891 that Thomas Robins first covered a conveyor belt with rubber and proved it tougher than steel when handling heavy bulk materials.

The rubber-covered belt is but one of scores of "firsts" to come from Hewitt-Robins . . . in belting, in hose, in machinery—in *better ways* to handle and process solid or fluid bulk materials.

Today you get still another "first" when you turn to Hewitt-Robins for belt conveyors. You get the *complete* job. Hewitt-Robins is the first and only organization in the world that supplies engineering, specialized machinery *and belting* from within its own corporate structure. Hewitt-Robins alone is able to take undivided responsibility from drawing board to production run.

Our three industrial Divisions work individually or as a team, depending upon the problem and your need. Next time materials handling is *your* problem, we invite you to make it *ours*.

HEWITT HR ROBINS

Executive Offices: 370 Lexington Avenue, New York 17, N. Y.

HEWITT RUBBER DIVISION: Belting, hose and other industrial rubber products
ROBINS CONVEYORS DIVISION: Conveying, screening, sizing, processing and dewatering machinery
ROBINS ENGINEERS DIVISION: Designing and engineering of materials handling systems

Hewitt-Robins is participating in the management and financing of Kentucky Synthetic Rubber Corporation

News

of men and companies

(Continued from page 125)

APPOINTMENTS

General Electric Co.—E. A Green is named mgr of product planning of the Small and Medium Motor Dept. S. V. Travis is appointed mgr of the newly-established sales standards section of the Apparatus Sales Div. N. Currie, Jr., general consultant for the Manufacturing Services Div. retired after 43 years of service.

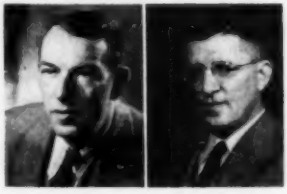
Minneapolis-Honeywell Regulator Co.—W. L. Gustafson has been named power industry sales mgr west of the Mississippi River.

National Electric Products Corp.—H. V. Ivory assumed his duties as plant mgr of the newly purchased million-dollar plant in Elizabeth, N. J.

Perfex Corp.—R. E. Kurrasch, has been appointed Chicago district mgr for the Controls Div.

The Reliance Electric & Engineering Co.—Promoted J. L. Fuller to the newly created administrative post of mgr of research and technical services.

Taylor Instrument Companies—At a recent meeting of the board of directors E. Olson was elected president, succeeding L. B. Swift who was named chairman of the board. F. S. Ward is now genl sales mgr and A. J. Fleig replaces him as industrial sales mgr. G. E. Heller and R. N. Pond become div sales mgrs.



E. Olson **A. H. Lamb**

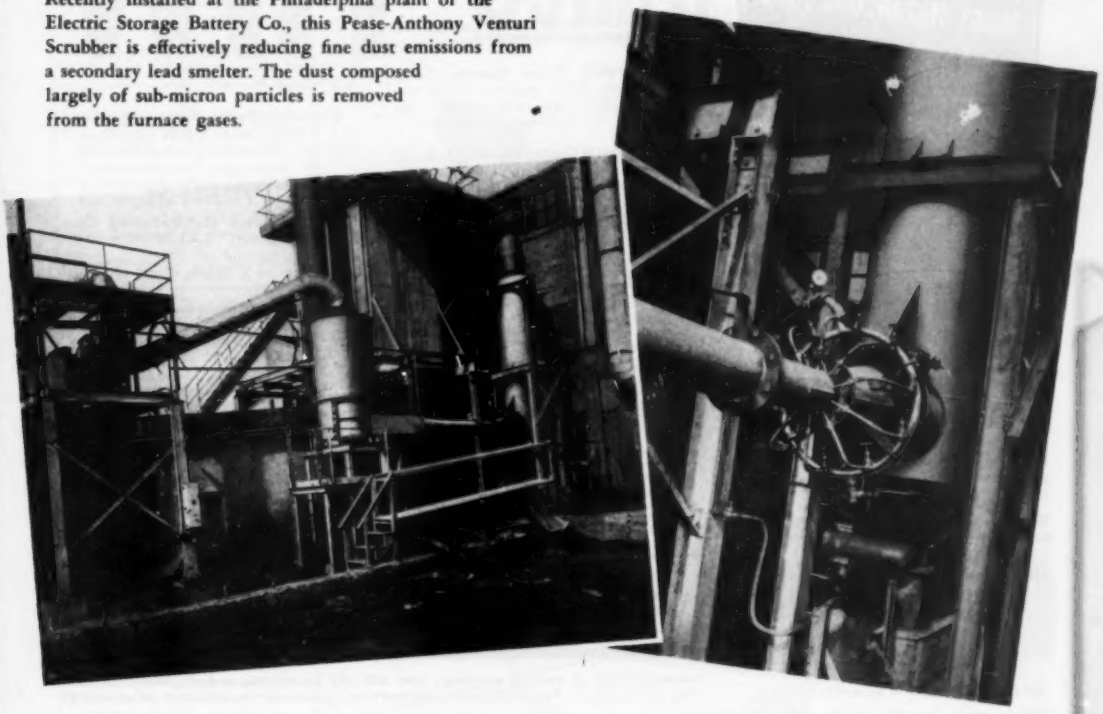
Weston Electrical Instrument Corp.—A. H. Lamb succeeds R. R. Lambe, retired, as v-p in charge of manufacturing. Other appointments include G. T. Deaney to position of genl supt of manufacturing and R. T. Pierce to chief production supt.

Rockwell Manufacturing Co.—Five regional managers are appointed. Eastern region is under the direction of M. J. Harper with headquarters in New York City. Central region is supervised by P. C. Kreuch with headquarters in Pittsburgh. Southern region will be headed by J. W. Northcutt with offices in Atlanta, Ga. Mid-Western region is under the jurisdiction of C. K. Madison with offices in Houston, Tex. Western region is managed by H. Boezinger with offices in Los Angeles, Calif.

(Continued on page 128)

Here's Efficient DUST and FUME Removal

Recently installed at the Philadelphia plant of the Electric Storage Battery Co., this Pease-Anthony Venturi Scrubber is effectively reducing fine dust emissions from a secondary lead smelter. The dust composed largely of sub-micron particles is removed from the furnace gases.



Other Typical Applications

Chemico P-A Venturi Scrubbers are now being used in a wide range of industries for the highly efficient removal of micron and sub-micron dusts and fumes. For a detailed analysis of your scrubbing problem, write or call our P-A Sales Department.

APPLICATION	MATERIALS BEING REMOVED	DUST AND FUME LOADINGS Inlet to Scrubber	Outlet from Scrubber
DUSTS			
Diatomaceous Earth Plant	Diatomaceous Earth	1.2 grains/scf	0.85 grains/scf
Rubber Blenders	Carbon Black	0.3 grains/scf	0.003 grains/scf
Yellow Brass Foundry Furnace	Zinc Oxide	3.5-10 grains/scf	0.7 grains/scf
Lime Kilns	Lime and Na_2O Fumes	7.0 grains/scf	0.02 grains/scf
Electric Furnace Fumes	Iron Oxide	0.2 grains/scf	0.03 grains/scf
Blast Furnace	Iron Oxide	4.0-20.0 grains/scf	0.008-0.08 grains/scf
Secondary Lead Blast Furnace	Lead and Rubber Compounds	1-10 grains/scf	0.05-0.20 grains/scf
FUMES			
Coppperas Roasting Plant	H_2SO_4 Mist	100-300 Mg/scf	1-5 Mg/scf
Titanium Plant	H_2SO_4 Mist	120 Mg/scf	2.0 Mg/scf
Phosphoric Acid Plant	H_3PO_4 Mist	100-300 Mg/scf	3.0 Mg/scf
Wood Distillation	Tar Fog and Acetic Acid Mist	1000 Mg/scf	10-40 Mg/scf
Enamel Smelting Furnace	Dust and Fluoride Fumes	55.0 Mg/scf	4.0 Mg/scf
Dry Ice Plant	Amine Fog	25.0 Mg/scf	5.0 Mg/scf

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

CABLES: CHEMICONST, NEW YORK

EUROPEAN TECHNICAL REPRESENTATIVE

CYANAMID PRODUCTS, LTD., NORTH WEST WING, BUSH HOUSE

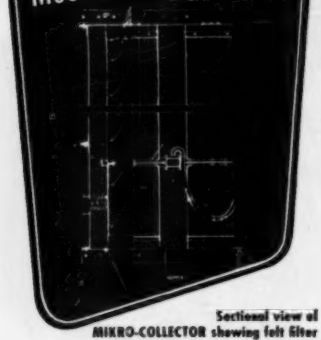
ALDWYCH, LONDON W.C. 2, ENGLAND

Chemico plants are profitable investments

CC 884

IF IT'S GOOD ENOUGH FOR ULTRA-FINE RADIOACTIVE DUSTS

IT'S IDEAL FOR YOUR MOST HAZARDOUS JOBS



Sectional view of MIKRO-COLLECTOR showing felt filter bags and reverse jet cleaning ring.

The MIKRO-COLLECTOR* has virtually no rival in the collection of radioactive dusts of ultra-fine particle size. Its installations for this purpose alone, during the past year, have a combined capacity of more than 100,000 cfm.

We can show you data which should leave no doubt in your mind that a MIKRO-COLLECTOR can handle your job economically and efficiently, if it falls in either of these classifications:

1—*Elimination of atmospheric pollution, regardless of the dangerous or noxious quality of the dust, or the minute size of the dust particles.*

2—*Full recovery of a valuable product.*

This is made possible by the MIKRO-COLLECTOR's pressed felt filter medium and its Hersey reverse-jet cleaning ring, which assure the very highest possible dust recovery.

10 Reasons

why a MIKRO-COLLECTOR will best help you win a war with Dust

1. Phenomenal Filter Rates
2. Highest possible recovery of solids
3. Require less filter surface, floor area
4. Extreme simplicity, low upkeep, minimum attention
5. Selected wool felt filtering medium
6. Reduced number of filter bags; quick changeover
7. Continuous, fully automatic operation
8. Uniform air flow
9. Easy handling of dust loads, damp or dry
10. Thorough survey and diagnosis of dust problem

SEND FOR—actual sample of felt used in MIKRO-COLLECTOR.

*Patents applied for by H. J. Hersey, Jr. and Pulverizing Machinery Company

PULVERIZING MACHINERY COMPANY
44 Chatham Road Summit, New Jersey

MIKRO-COLLECTOR
By the makers of
MIKRO-PULVERIZERS and MIKRO-ATOMIZERS

News

of men and companies

(Continued from page 126)

APPOINTMENTS

Round California Chain Co.—A. H. Luchs, genl mgr, has been elected v-p.

The Timken Roller Bearing Co.—R. E. Cook, field engineer with the Cleveland office, has been named sales engineer of the Steel and Tube Div.

United States Gasket Co.—H. S. Scott is named genl sales mgr of both the Gasket and Packing Div. and their Fluorocarbon Products Div. He formerly was sales mgr of Raybestos-Manhattan's Packing Div.

United States Rubber Co.—Appointment of H. B. Allison as district sales mgr of the Philadelphia branch, mechanical goods div, was announced.

Waukesha Motor Co.—The board of directors has announced the election of C. E. Nelson, Jr. as a director.

Westinghouse Electric Corp.—H. H. Hanft is named asst to the mgr of the industrial dept.

Whitney Chain Co.—J. H. Anthony, mgr of the Industrial Engineering Div., is appointed plant supt in addition to his existing duties.

J. A. Zurn Mfg. Co.—E. J. Morgan is now associated with the industrial div of the Chicago office.

Aluminum Company of America.—Dr. F. C. Frary retired as director of research Jan. 1, 1952.

Perfex Corp.—H. H. Hatch, mgr of the repair dept for the Controls Div. is named service mgr.

D. J. Murray Mfg. Co.—R. Buechler is named sales engineer with headquarters at Wausau, Wis.

Watson-Stillman Co.—Appointment of J. Kemper as genl mgr of sales, Distributor Products Div. is announced.

OBITUARIES

Allis-Chalmers Manufacturing Co.—E. H. Hortsman, 52, chief engineer for the steam turbine section of the power dept, died of a heart attack at North Freedom, Wis.

Caterpillar Tractor Co.—The death of R. C. Force, first president of the company and a member of its board of directors, occurred recently in Oakland, Calif.

Richardson Scale Co.—Founder and chairman of the board, H. Richardson died early in December.

The Rust Engineering Co.—C. G. Thornburgh, a v-p died suddenly from a heart attack suffered at his home, Rosslyn Farms, near Carnegie, Pa.

Meetings and exhibitions

Announcement of coming meetings that will aid executives and engineers in planning itineraries. For additional information, please write sponsors of meetings

JANUARY

The Plant Maintenance Show will be held at Convention Hall, Philadelphia, Jan. 14-17, 1952. Write Clapp & Poliak, Inc., 341 Madison Ave., New York 17.

FEBRUARY

Instrument Society of America. The New York Section announces that plans are rapidly developing for its Power Plant Symposium to be held at the Hotel Statler, New York, Feb. 7-8, 1952. Contact Richard Rimbach, 551 5th Ave., New York 17, N. Y.

MARCH

National Power Show—Midwest Power Conference. Being held concurrently March 25-28, 1952, at the Hotel Sherman, Chicago, Illinois. Write A. F. Thompson, Director of Exhibits, 176 West Adams Street, Chicago 3, Illinois.

National Association of Corrosion Engineers holds its Eighth Annual Conference and Exhibition at the Pleasure Pier in Galveston, Tex., March 10-14, 1952.

National Plastics Exposition will take place in Exposition Hall, Philadelphia, March 11-14, 1952. For further information write Harry W. Smith, Inc., 507 Fifth Ave., New York 17, N. Y.

Chicago World Trade Conference will be held in the Hotel Sherman March 6-7, 1952. The Chicago Assn. of Commerce and Industry, 1 N. LaSalle St., Chicago.

Chicago International Trade Fair is scheduled for March 22 through April 6, 1952, at Navy Pier. Headquarters Merchandise Mart, Chicago 54, Ill.

American Society of Tool Engineers holds its 9th Bi-ennial Industrial Exposition in Chicago, March 17-21, 1952, at the International Amphi-theatre. ASTE headquarters 10700 Puritan Ave., Detroit 21, Mich.

APRIL

American Society of Lubrication Engineers holds its Seventh Annual Meeting and Lubrication Show at the Hotel Statler in Cleveland, Ohio, April 7-9, 1952.

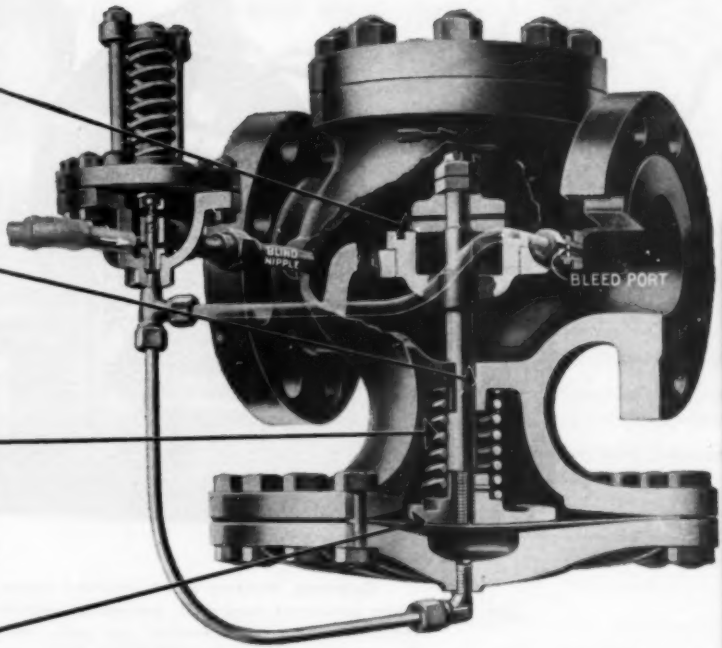
WHY Spence Regulators Outlast The Field

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. More than *twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.



Spence Type EQ back pressure regulator — operation of main valve is controlled by a sensitive pilot to regulate the initial pressure. Same pilot is used with all sizes of main valves.

The features shown above explain why you profit on every important count with Spence Pressure and Temperature Regulators.

Learn more about these and many other advantages of Spence Regulators by sending for Bulletin 350.

DURABILITY — Spence Regulators perform dependably year after year.

ACCURACY — You can be sure of accurate control for the life of the regulator.

MAINTENANCE — You don't need expensive repairs or special maintenance. That means less down-time, less time and money wasted on replacement of parts.

SR-110

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence

FOR PERFORMANCE YOU CAN **BANK** ON

Operating economy *is* an important factor in the selection of steam generating equipment; but equally important is dependability. These two basic considerations are such well-known attributes of Superior Steam Generators that Superior units are repeatedly specified for public utilities, hospitals, industrial plants, and similar critical installations.

Superior Steam Generators are built to develop their maximum rated capacities at thermal efficiencies guaranteed to exceed 80% . . . not for a day, or a month, but for years to come.

You can ***bank*** on their savings due to operating economy . . . but, more important, you can ***bank*** on the dependability of Superior Steam Generators for years of trouble-free service.

FOR COMPLETE DETAILS, WRITE TODAY FOR THE NEW FULLY ILLUSTRATED CATALOG 402 . . .

Fully automatic. Burns gas, or oil, or both.
18 sizes ranging from 20 up to 600 b.h.p.
for pressures to 250 p.s.i. or for hot water.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

SUPERIOR
STEAM GENERATORS

3 *special departments featured monthly to give you FREE bulletins, catalogs and product data screened for your personal interest in*

ENGINEERED PLANT SERVICES

1. NEW EQUIPMENT

Begins on page 8

Contains highlights of new products by leading manufacturers, briefed and illustrated for your easy reference. Complete data on each of these products are available ***free.***

2. NEW BULLETINS

Begins on page 28

Includes descriptions of only those bulletins and catalogs that are really ***new*** and of ***direct value*** to you — saves your reading time, yet gives you full service. All bulletins sent to you ***free*** on request.

3. READERS GUIDE TO ADVERTISED PRODUCTS

Begins on page 133

Designed to catalog advertised products for your convenience in finding the ads which are of special interest to you at this time. Also lists those important bulletins, catalogs and working data offered ***free*** in the advertisements.

REQUEST CARD FOR LITERATURE OR MORE INFORMATION—Jan., 1952

To: INDUSTRY AND POWER, St. Joseph, Mich. Please have forwarded to me, at no obligation, the free literature I've indicated by the following key or paragraph numbers:

New Equipment begins Page 8	*New Bulletins begins Page 28*	*Advertised Products begins Page 133*
No.'s	No.'s	No.'s

Your Name _____ **Title** _____

Your Company _____

Co. Address (St. & No.) _____

City _____ **State** _____

Inquiries for items listed in this issue not serviced beyond May 1, 1952

FIRST CLASS
PERMIT No. 19
(Sec. 34.9, P.L.&R.)
ST. JOSEPH, MICH.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

3¢—POSTAGE WILL BE PAID BY

INDUSTRY AND POWER
420 MAIN STREET
ST. JOSEPH, MICH.

3 *special departments featured monthly to give you FREE bulletins, catalogs and product data screened for your personal interest in*

ENGINEERED PLANT SERVICES

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Contains highlights of new products by leading manufacturers, briefed and illustrated for your easy reference. Complete data on each of these products are available **free.**

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Your Name _____ Title _____

Your Company _____

Co. Address (St. & No.) _____

City _____ State _____

Inquiries for items listed in this issue not serviced beyond May 1, 1952

Readers' guide to advertised products

This department is both a product index for advertising and a keyed listing for advertised literature. Refer to advertisement on page indicated and contact advertiser directly—or list paragraph key numbers on reader service card (page 131) to get data you want

AIR & DUST FILTERS & COLLECTORS

Dust Collectors **500**
Bulletin with complete data on American Blower dust collecting equipment. American Blower Corp. Adv. page 58.

Dust Collectors **501**
Norblo centrifugal, hydraulic and bag type collecting systems. The Northern Blower Co. Adv. page 103.

Dust Collectors **502**
Prat-Daniel Corp. tubular dust collectors (Bulletin 260D). The Thermix Corp. Adv. page 27.

Dust Collectors **503**
Aerotec Corp. Series Mechanical-Electrical Dust Collectors. The Thermix Corp. Adv. page 124.

Dust Collecting System **504**
Schneible Multi-Wash Dust Collecting System. Claude B. Schneible Company. Adv. page 53.

Electrical Precipitator **505**
Cottrell Precipitator (Bulletin FA). Research Corp. Adv. page 42.

Dust Collector **506**
Bulletin describes Buell Dust Collection. Buell Engineering Co. Adv. page 47.

Mikro-Collector **507**
Free sample of felt used in Mikro-Collector for collection of radioactive dusts. Pulverizing Machinery Co. Adv. page 128.

Dust Control Systems **508**
Information on engineered dust and fume control systems. The Kirk & Blum Mfg. Co. Adv. page 135.

Air Pollution Control **509**
Descriptive literature on electrostatic, mechanical and combination of both collectors. Western Precipitation Corp. Adv. page 99.

Dust Removal **510**
Applications for Pease-Anthony Venturi scrubbers. Chemical Construction Corp. Adv. page 127.

Dust Control **511**
Duclone Collectors described in catalog DC49-11. The Ducon Co. Adv. page 116.

ANTI-CORROSIVE & PROTECTIVE COATINGS

Rust Preventive **512**
Information on Rust-Oleum sealing compound. Full range of colors. Rust-Oleum Corp. Adv. page 59.

BOILERS & BOILER ACCESSORIES

Overfire Jets **513**
Catalog tells about smoke abatement through application of air over the fire. Plibrico Jointless Firebrick Co. Adv. page 112.

BUILDING HEATING, VENTILATING, AIR CONDITIONING & REFRIGERATION

Air Conditioning **514**
Information on Trane heating, cooling ventilating, and air conditioning equipment. The Trane Co. Adv. page 159.

BUILDING MATERIALS & MAINTENANCE

Maintenance Handbook **515**
40-page Handbook on communtator and slip ring maintenance. Ideal Industries, Inc. Adv. page 139.

Iron Cement **516**
Free Repair Handbook describes Smooth-On repairs. Smooth-On Mfg. Co. Adv. page 163.

Thread Compound **517**
Free sample and data sheet on Fel-Pro C-5 "Hi-Temp" Thread Compound. Felt Products Mfg. Co. Adv. page 138.

COAL, ASH & BULK HANDLING

Conveyor Belting **518**
Engineering, specialized machinery and conveyor belting. Hewitt-Robins. Adv. page 126

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Pipe & Fittings 137
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Readers' guide to advertised products

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Ash Handling **519**
Beaumont hydraulic ash-handling system (brochure: "Answers to Your Ash-Handling Questions"). Beaumont Birch Co. Adv. page 142.

Coal Handling **520**
Link-Belt Coal Handling Equipment. Link-Belt Company. Adv. page 3.

Coals **521**
Information on Bell and Zoller coals. Bell and Zoller Coal Co. Adv. page 40.

Locomotives **522**
Information on Porter Davenport-Built Fireless Locomotives. Davenport Locomotive Div., Davenport Besler Corp. Adv. page 150.

COMPRESSORS

Compressors, Motor Driven **523**
Clark balanced opposed, motor-driven compressors. Range 150-4500 bhp. Clark Bros. Co., Inc. Adv. page 100.

Compressors **524**
Information on CP steam and motor-driven compressors. Chicago Pneumatic Tool Co. Adv. page 141.

CONTROLS, REGULATORS & INSTRUMENTS

Tank Gage **525**
Complete details on Liquidometer tank gage. The Liquidometer Corp. Adv. page 163.

Regulators **526**
Spence Pressure and Temperature Regulators (Bulletin 350). Spence Engineering Co., Inc. Adv. page 129.

Regulators **527**
Powers Accritem Regulator and Diaphragm Valves (Bulletin 316). The Powers Regulator Co. Adv. page 109.

Regulators **528**
Bulletin 50-1000 gives details on patented Stacon regulator. Farris Stacon Corp. Adv. page 152.

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Regulators **529**
Boiler feed regulators, Henszey Co. Adv. page 142.

Smoke Measurement **530**
Indicating, recording or monitoring with "Electric Eye" instruments. Ess Instrument Co. Adv. page 138.

CRANES, HOISTS & CAR PULLERS

Handling Equipment **531**
Silent Hoist Krane Kar and Car Pullers (Bulletins 79 and 64A). Silent Hoist & Crane Co. Adv. page 162.

DEHYDRATION EQUIPMENT

Hydryer **532**
Pritchard Hydryer for dehydration (Bulletin 16.0.080). J. F. Pritchard & Co. Adv. page 148.

ELECTRICAL DISTRIBUTION

Mechanical Rectifiers **533**
I-T-E Mechanical Rectifier (Bulletin 5106). I-T-E Circuit Breaker Co. Adv. page 24, 25.

Fuses **534**
Fusetron Dual-Element Fuses. Bussmann Mfg. Co. Adv. page 18, 19.

Sealtite Electrical Conduit **535**
Sealtite flexible electrical conduit (Bulletin C-188). The American Brass Co., American Metal Hose Branch. Adv. page 55.

Magnetic Starters **536**
Information describes Type "RA" Magnetic Starters. The Arrow-Hart & Hegeman Electric Co. Adv. page 122.

Fuses **537**
Price list and catalog on "Economy De-Lay" Renewable Fuses. Economy Fuse and Mfg. Co. Adv. page 164.

FANS & BLOWERS

Fans **538**
Clarage Type RT heavy-duty fans (Catalog 901). Clarage Fan Company. Adv. page 4.

FILTERS, STRAINERS & PURIFIERS

Flo-Klean Strainers **539**
Information on Cuno Flo-Klean Strainers. Cuno Engineering Corp. Adv. page 36.

FUELS & FIRING EQUIPMENT

Stokers **540**
Erie City "Travagrate" spreader stokers (Catalog SB42-A). Erie City Iron Works. Adv. page 14, 15.

Stokers **541**
Westinghouse Centrafire with Traveling Grate. Westinghouse Electric Corp. Adv. page 21.

(Continued on page 136)

withstands 50% higher speeds

the NEW LOVEJOY FLEXIBLE COUPLING

Increases in speed up to 50% are handled with complete safety by this new Lovejoy Flexible Coupling. The secret is a special multiple leaf spring that holds the collar in place. As with all Lovejoy Couplings, the new model instantly adjusts for misalignment, vibration, surge or backlash. Half of the cushions are idlers — except on reversing load — so a new set is always in the coupling. Shutdowns are eliminated, since load cushions are quickly interchanged without tearing down coupling. Quiet operation with no lubrication ever needed. Lovejoy Couplings are for services from 1/6 to 2,500 H.P.

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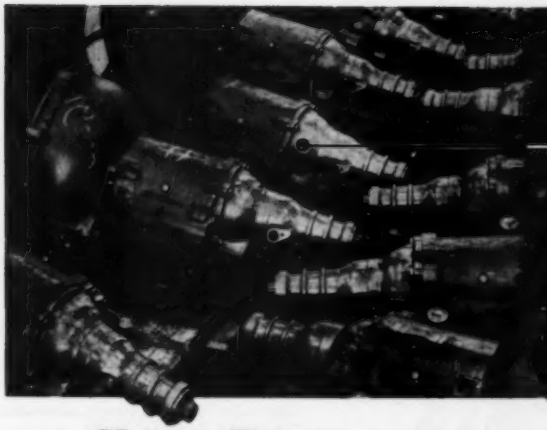
Also Mfrs. of Lovejoy Universal Joints and Lovejoy Variable Speed Transmissions



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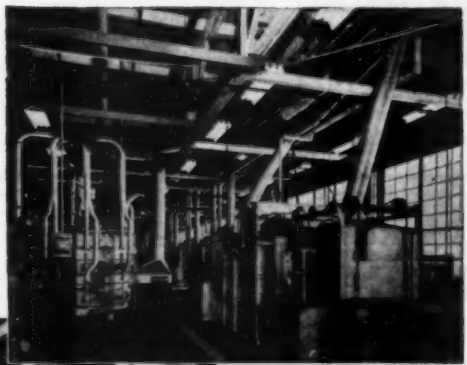
at work in the

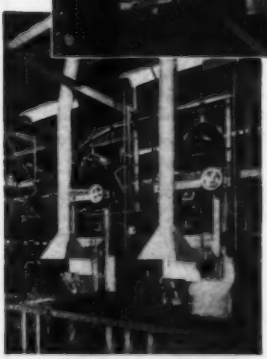
FORD AUTOMATIC TRANSMISSION PLANT

NUMBER 1 OF A SERIES

KIRK AND BLUM SYSTEMS CONTROL FUMES IN HEAT TREATING



View of part of Ford Automatic Transmission heat treating department. At left, rotary hardening furnace; center, quenching tank with cross draft ventilation; at right, combination washing machine and drawing furnace.



Small general purpose heat treating furnaces. Hood over loading door collects fumes; products of combustion exhausted by separate piping at rear of each furnace.

In the ultra-modern Ford Motor Company Automatic Transmission Plant, 37 distinct KIRK & BLUM Systems aid in the production of Merc-o-Matic and Ford-o-Matic transmissions.

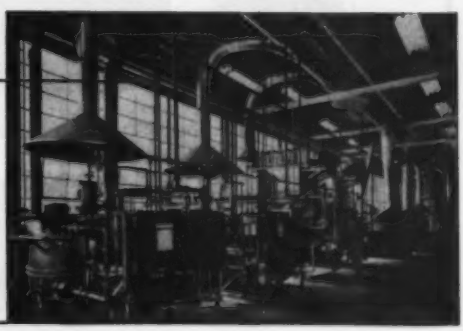
In heat treating, quenching, welding, cleaning, machining, woodworking, maintenance and assembly operations, they provide "Clean Air . . . the INVISIBLE Tool" in this model plant.

Efficient control of smoke and fumes in a heat treating department of this size is a complicated job. The various KIRK & BLUM systems shown here, with others, exhaust more than 130,000 CFM. A separate system furnishes tempered air to replace that exhausted.

Let the 45 years' experience of KIRK & BLUM work for you. Write for literature and detailed information.

The Kirk & Blum Manufacturing Co., 3174 Forrer Street, Cincinnati 9, Ohio.

Gas generating equipment; each unit is individually exhausted by a centrally located Kirk & Blum System.



KIRK AND BLUM

FUME CONTROL SYSTEMS

Readers' guide to

advertised products

(Continued from page 134)

RotoGrate Stokers **542**
Catalog describes Detroit RotoGrate Stokers. Detroit Stoker Co. Adv. page 26.

Coal & Ash Handling Machinery **543**
Jeffrey coal and ash handling machinery (Catalog 778-A). The Jeffrey Mfg. Co. Adv. page 41.

Coal Handling Equipment **544**
Bulletin No. 300 describes the Gifford-Wood coal handling system. Gifford-Wood Co. Adv. page 121.

Stokers **545**
Hoffman Industrial Stokers. Hoffman Combustion Engineering Co. Adv. page 31.

Coals **546**
Full information on bituminous coal. Bituminous Coal Institute. Adv. page 111.

Coals **547**
Smoke problem? Beacon Combustion Service Man may help you. Eastern Gas & Fuel Associates. Adv. page 119.

Gas Burner **548**
Series B22 bulletins give the whole story on Webster Rectilinear Gas Burner for gas firing over or beside stokers and oil burners. The Webster Engineering Co. Adv. page 113.

HEAT EXCHANGER EQUIPMENT

Heat Exchanger **549**
Vogt condenser tower. Henry Vogt Machine Co. Adv. page 155.

Steam Fan Heater **550**
Niagara High Pressure Steam Fan Heater (Bulletin 109). Niagara Blower Co. Adv. page 146.

Deaerators **551**
Information on Worthington deaerating heaters and deaerators. Worthington Pump & Machinery Corp. Adv. page 147.

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LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

Lubricants **552**
Nonpareil turbine oil. Standard Oil Co. (Indiana). Adv. page 57.

Oils & Greases **553**
Recommendation charts for industrial applications. Adam Cook's Sons. Adv. page 148.

MECHANICAL POWER TRANSMISSION

Roller Chains **554**
Atlas Roller Chain (Catalog and Handbook No. 51-IP). Atlas Chain & Mfg. Co. Adv. page 38.

Belts **555**
Flat belts, V-belts and conveyor belts ("Exclusive Features" book). Raybestos-Manhattan, Inc. Adv. page 43.

V-Belts **556**
Goodrich Grommet Belts. B. F. Goodrich. Co. Adv. pages 49, 50, 51, 52.

V-Belts **557**
Gates Vulco Ropes. The Gates Rubber Company. Adv. page 23.

Cog-Belts **558**
Information on Dayton Cog-Belts. Dayton Rubber Co. Adv. pages 10, 11.

Nicholson Makes

FREEZE-PROOF STEAM TRAPS

for Every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates steam transfer in severe weather.

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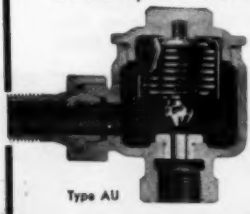
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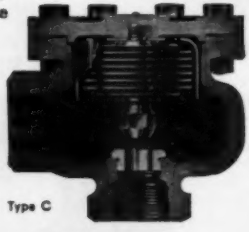
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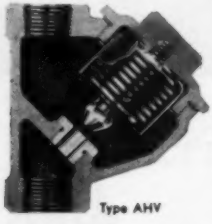
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135 OREGON ST., WILKES-BARRE, PA.

Representatives, in 53 Principal Cities, to Help You Solve Specification and Maintenance Problems in Traps, Floats, Control Valves

Flexible Couplings 559

Catalog gives handy selector charts. Lovejoy Flexible Coupling Co. Adv. page 134.

Sheaves 560

Bulletin V-1400-B7F shows how it's easy to switch sheave sizes. Worthington Pump and Machinery Corp. Multi-V-Drive Sales Div. Adv. page 56.

PACKAGED STEAM GENERATORS

Generator 561

Bulletin 1011-C with complete data on the Amesteam Generator. Ames Iron Works. Adv . page 153.

Generators 562

Clayton Forced Recirculation Steam Generators (catalog). Clayton Mfg. Co. Adv. page 125.

Generators 563

Superior Steam Generators (Catalog 402). Superior Combustion Industries Inc. Adv. page 130.

PACKING & GASKETS

Packings & Gaskets 564

Catalog describes R/M packings and gaskets. Raybestos-Manhattan, Inc., Packing Div. Adv. page 108.

Gaskets 565

Information on Ajax Spiralwound gaskets. United States Gasket Co. Adv. page 160.

PIPE & FITTINGS

Flexible Joints 566

Barco Flexible Ball Joints (Bulletin No. 215). Barco Mfg. Co. Adv. page 137.

Piping Layouts 567

Jenkins Piping Layouts (Layout No. 57). Jenkins Bros. Adv. page 9.

Flexible Metal Hose 568

Catalog 500 gives details on "Atlantic" seamless or interlocking, in bronze, steel, stainless steel, monel. Atlantic Metal Hose Co., Inc. Adv. page 152.

PUMPS

Pumps 569

I-R HMTA high-pressure centrifugal pumps (Bulletin 7233). Ingersoll-Rand. Adv. page 39.

Pumps 570

Weinman pumps. The Weinman Pump Mfg. Co. Adv. page 118.

(Continued on page 138)

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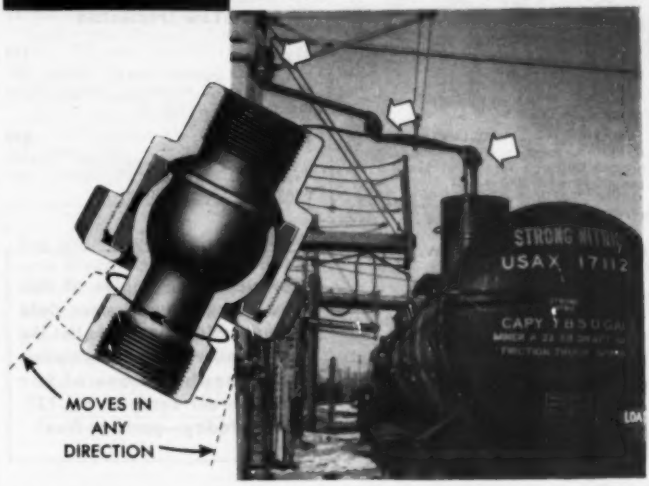
BARCO

Flexible

BALL JOINTS



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—when you need movable joints in piping handling

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BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING AND REVOLVING JOINTS

Readers' guide to

advertised products

(Continued from page 137)

Hydraulic Descaling **571**

Bulletin on double volute pump as applied to hydraulic descaling. Byron Jackson Co. Adv. page 107.

REFRACTORIES

Cement Linings **572**

Lumnite calcium-aluminate cement for baffles, furnace walls, arches, door linings. Lumnite Div., Universal Atlas Cement Co. Adv. page 44.

Refractories **573**

B & W Kaocast, 3000° refractory castable. The Babcock & Wilcox Co., Refractories Div. Adv. page 33.

Refractory Cements **574**

Catalog describes R&I Moldit Refractory Cements. Refractory & Insulation Corp. Adv. page 156.

Jointless Firebrick **575**

Catalog on Plibrico refractory products for boiler settings and furnace enclosures. Plibrico Jointless Firebrick Co. Adv. page 112.

SOOT BLOWERS & TUBE CLEANERS

Midget Tube Cleaners **576**

Information on Airtool's midget tube cleaners. Airetool Mfg. Co. Adv. page 154.

Tube Expanders **577**

Information on Series 1500 tube expanders. The Gustav Wiedeke Co. Adv. page 158.

STEAM SPECIALTIES

Traps **578**

Yarway Impulse Steam Traps (20-page Selector Booklet). Yarnall-Waring Co. Adv. page 60.

Traps **579**

Sarco Liquid Expansion Steam Traps (Bulletin No. 260). Sarco Company, Inc. Adv. page 46.

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Traps **580**

36-page steam trap book gives complete details on Armstrong traps. Armstrong Machine Works. Adv. page 2.

Supply Valves & Traps **581**

Thermo traps and supply valves described in bulletins. Illinois Engineering Co. Adv. page 152.

Traps **582**

Catalog 751 (or see Sweet's) tells all about freeze-proof steam traps. W. H. Nicholson & Co. Adv. page 136.

THERMAL INSULATION

Insulating Cement **583**

All purpose Black Rockwool Insulation. Baldwin-Hill Co. Adv. page 115.

TOOLS

Pipe Tools **584**

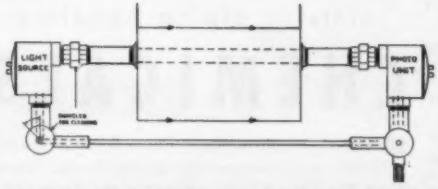
Catalog with data on complete line of Toledo Pipe Tools and Power Pipe Machines. The Toledo Pipe Threading Machine Co. Adv. page 140.

Blower Suction Cleaner **585**

Clements-Cadillac portable blower-suction cleaner. 5 Models with attachments. Clements Mfg. Co. Adv. page 152.

Masonry & Concrete Saws **586**

Clipper masonry and concrete saws. Clipper Manufacturing Co. Adv. page 37.



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SAFE for Stainless and Alloy Steels, too, will not pit or corrode!

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Snap-On Tools **587**

Industrial Catalog and 104-page general catalog describe Snap-on Tools. Snap-On Tools Corp. Adv. page 32.

Tools **588**

Send 10c for 68-page catalog of Proto tools. Plomb Tool Co. Adv. page 6.

TURBINES

Turbines **589**

Type E Turbines (Book B-3896). Westinghouse Electric Corp. Adv. page 29.

Turbines **590**

Terry Solid-Wheel Turbine (Bulletin S-116). The Terry Steam Turbine Co. Adv. page 54.

Turbines **591**

Bulletin 135 describes the Coppus Steam Turbine line. Coppus Engineering Corp. Adv. page 45.

Turbines **592**

Information on Worthington Steam Turbines. Worthington Pump & Machinery Corp., Steam Turbine Div. Adv. page 145.

VALVES

Blow-Off Valves **593**

Bulletins describe Yarway Unit Tandem Blow-Off Valves. Yarnall-Waring Co. Adv. page 117.

Valves **594**

Chapman steel valves — gate, globe, angle or check. The Chapman Valve Mfg. Co. Adv. page 48.

Valves **595**

Darling cast steel gate valves (bulletin). Darling Valve & Mfg. Co. Adv. page 35.

Valves **596**

Crane pressure-seal bonnet gate valves (Circular Ad-1819). Crane Co. Adv. page 7.

Diaphragm Valves **597**

Bulletin 513 describes Leslie Double Seated Diaphragm Valves. Leslie Co. Adv. page 104.

(Continued on page 140)

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Another PALMETTO PALCO Success Story

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Paterson, N. J.

CHIEF ENGINEER: Ralph Allan

DATA: DeLaval Centrifugals. Operating conditions — 3600 RPM, 90 ft head pumping through filter, cold spring water 1200 gpm, 40 hp motor, shaft 1-1/2", 3/8" PALMETTO Palco packing. Repacking every 2-3 yrs during routine inspection.

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restores commutators and slip rings at low cost without dismantling . . . keeps motors running like new . . . saves overhauls and shutdowns

RESURFACERS
Refinish commutators and rings to like-new condition even when ridged, scored or burned.

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Stop sparking—help commutation—prolong brush life. For all sizes of commutators.

PRECISION GRINDERS
For more than surface smoothing — under machine's own power. Accurate to .001"

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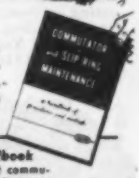
Cleans and burnishes commutators. Non-dusting. Complete size range.



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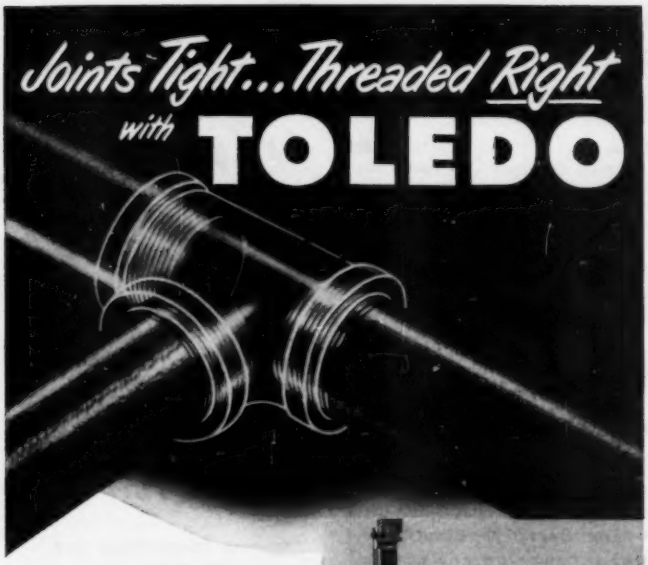

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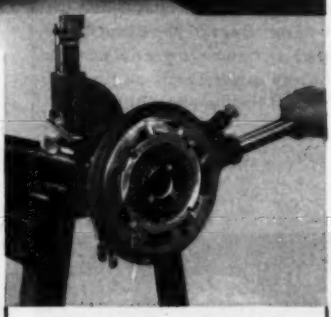
SPEED PRODUCTION
... CUT COSTS!

Any way you look at it—you'll do better with TOLEDO Pipe Tools and Power Pipe Machines on the job!

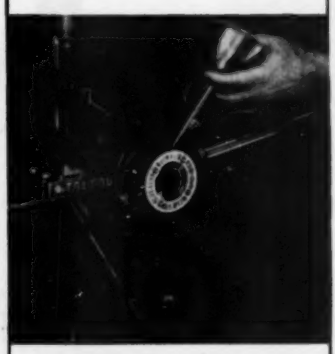
Better workmanship . . . good mechanics for fifty years have found they can always depend on TOLEDO to produce clean-cut threads for tight, leak-proof joints.

Faster production . . . whether it's hand tools or power pipe machines, Toledo gives you top-speed threading, cutting and reaming . . . ease of operation . . . accurate, efficient performance.

Lower costs . . . it all adds up to *big savings for you* in job-time and labor with Toledo dependability! Write for catalog on complete line. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.



Toledo SIMPACT — self-contained, adjustable threader, 1" to 2" pipe.



Toledo Small Ratchet Threaders made in three models, ⅛" to 2" pipe.

Toledo No. 999 2" pipe machine, wheel or knife cut-off.

RELY ON THE LEADER

TOLEDO

PIPE TOOLS...POWER PIPE MACHINES...POWER DRIVES

Readers' guide to advertised products

(Continued from page 139)

Valves **598**
The W. S. Rockwell Valve News describes Rockwell automatic and manually controlled valves. W. S. Rockwell Co. Adv. page 156.

Valves **599**
Catalog with information on Sims Valves. Sims Pump Valve Co., Inc. Adv. page 158.

WATER TREATMENT

Water Treatment **600**
Bulletins 5008 and 5000 describe Dearborn Polyamide Anti-Foams and Industrial Water Treatment and Engineering Service. Deaborn Chemical Co. Adv. page 123.

Water Treatment **601**
Nalco water conditioning system (ASME paper, "Correlation of Silica Carry-over and Solubility Studies"). National Aluminate Corp. Adv. page 13.

Water Treatment **602**
Bird-Archer's 8 Point Water Treatment Service. The Bird-Archer Co. Adv. page 151.

Water Conditioning **603**
Information on boiler feedwater treatment and free copy of "Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater". Graver Water Conditioning Co., Div. of Graver Tank & Mfg. Co. Adv. 157.

Water Treatment **604**
Complete story on carryover and blowdown control with anti-foam agents (Technical Paper No. 115). W. H. & L. D. Betz. Adv. page 17.

Waste Treatment **605**
Free copy of "Reference Bibliography for Water, Sewage and Power Plant Engineering." Gilbert Associates, Inc. Adv. page 165.

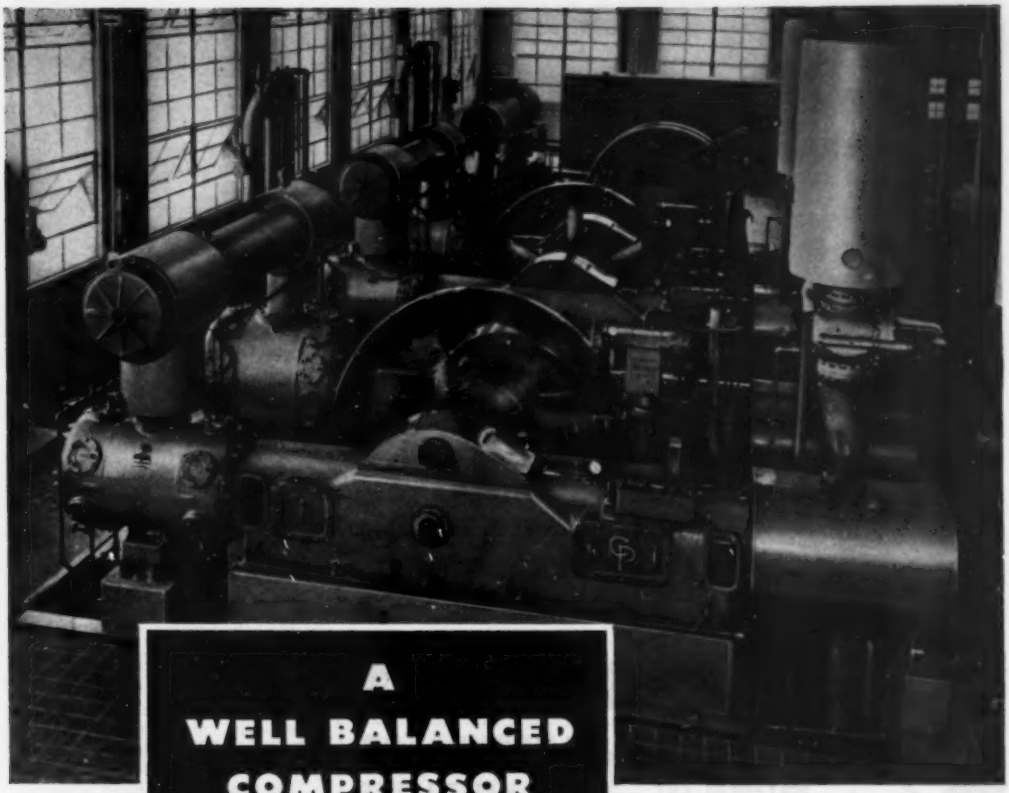
Softeners & Filters **606**
Old units can be transformed into up-to-date facilities. Hungerford & Terry, Inc. Adv. page 162.

MISCELLANEOUS

Packings **607**
Tips on how to make packings last longer. Johns-Manville Corp. Adv. page 149.

Diesel Engine **608**
Worthington Supercharged diesel engine. Worthington Pump and Machinery Corp., Engine Div. Adv. page 143.

Valves & Regulators **609**
Coupon brings information on Campbell feedwater regulator and other types of regulators and valves. Atlas Valve Co. Adv. page 144.



A WELL BALANCED COMPRESSOR INSTALLATION

This CP installation in one of the country's largest automobile plants — three 500 horsepower compressors, one motor-driven and two steam-driven — is a good example of effecting heat balance.

Such combinations of steam and motor-driven compressors provide a desirable flexibility of operation and reduce power costs particularly in plants where exhaust steam can be utilized for process work or for heating.

CHICAGO PNEUMATIC TOOL COMPANY

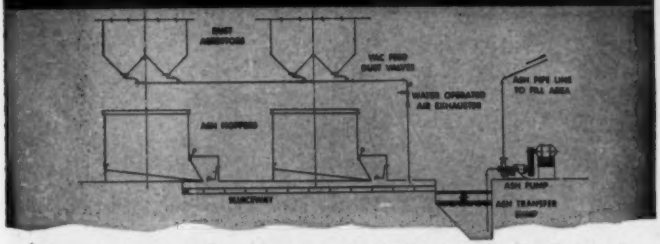
General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Write for complete information.

Need Large Capacity Ash-Handling?

CHECK WITH BEAUMONT ON A HYDRAULIC ASH-HANDLING SYSTEM



A Beaumont HYDRAULIC System is particularly suited for high capacity ash-handling; handles wet ash or dry, molten slag and large clinkers; fits any type of power plant arrangement; is completely enclosed, preventing dust or gas from escaping to the boiler room; and can be operated by one man on a part time basis.

Beaumont's Ash-Handling Division is competently staffed to give you expert recommendations on all types of ash-handling systems . . . and to provide and install the proper equipment to suit your particular requirements. Write today for the Beaumont brochure: "Answers to Your Ash-Handling Questions".

Beaumont BIRCH COMPANY

1509 RACE STREET, PHILADELPHIA 2, PA.

DESIGNERS—MANUFACTURERS—ERECTORS BULK MATERIAL HANDLING SYSTEMS

HENSZEY *Boiler Feed* REGULATOR

***Keeps a* WATCHFUL EYE *on* BOILER WATER LEVELS**

• CONTINUOUSLY • AUTOMATICALLY • ACCURATELY *under* ALL LOAD CONDITIONS

They help avoid the hazards of high, as well as low, water levels. They function night and day—once installed and set for operator no attention is necessary — nothing to get out of order — nothing to rust.

A simple, compact unit — installs right in the line—no additional supports are necessary. Pressures up to 600 lbs., sizes up to 4 in. For details consult Sweet's Catalog or write:

HENSZEY COMPANY
DEPT. A1, WATERTOWN, WISCONSIN

HENSZEY

BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

Cross-Fired Stokers

(Continued from page 66)

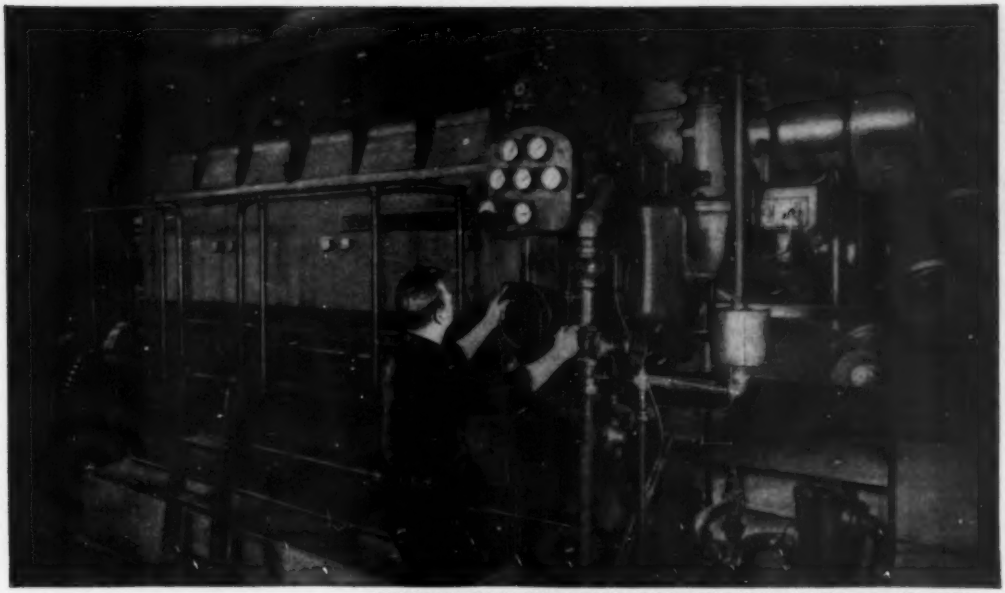
gas release does not vary from front to rear of the modern spreader stoker as it does with other types. Accordingly, the boiler plant designer now has at his option either (1) the conventional practice of fitting the width of the stoker to the width of boiler or (2) the practice of cross-firing which means that the length of the stoker is fitted to the width of the boiler.

"Cross-firing with spreader stokers is undoubtedly just in its inception. Professor Tor Langon, the Dutch consulting engineer, spotted the possibilities of cross-firing for small sized units early in 1951. This was in connection with the new steam plant for the Beukema Strawboard and Paper Carton factory in Hoogezand, Holland; see Table 2 and Fig. 2 for specifications and drawing of this boiler. For a small unit, having in this case a capacity of 35,200 lb of steam per hr, he realized that cross-firing would enable him to use a fairly wide boiler which would provide the large steam drum capacity he specially required without, at the same time, having to buy a stoker and fuel equipment which would be wider and more expensive than it need be merely to suit the width of the boiler. Accordingly, cross-firing and spreader stokers have been adopted for that plant.

"Mr. Bennett has in mind, of course, the converse case in which cross-firing enables the plant designer to meet the requirements of the combustion process by using a wider stoker than could be accommodated in the normal width of the boiler. Nevertheless, cross-firing, whatever its object, is entirely feasible. In fact, it is one of the most important developments which we have had in boiler plant practice, in any country, for some time. Potentially, it will carry spreader stoker firing forward into the field of 500,000 lb per hr boiler units with important reduction in steam generating costs to the user including not only reduced capital charges, but low power consumption as well."

DON'T CLIP—DON'T TEAR
WRITE FOR TEAR SHEETS!

Rather than spoil this issue for other readers in your plant, let us supply you with copies or tear sheets of any of the articles for your files. Just drop a line to the editors, preferably on company letterhead, for articles desired.



WORTHINGTON SUPERCHARGED DIESEL ENGINE at Kalamazoo Paper Co., Kalamazoo, Michigan, driving 600-kw generator.

Kalamazoo Paper Co. guards against costly shutdowns with heavy-duty diesel generator

Company installs Worthington supercharged diesel and 600-kw generator for stand-by

An insurance policy against costly shutdowns! Such is the attitude of Kalamazoo Paper Company management towards the Worthington medium-speed, heavy-duty diesel they've installed for stand-by service.

Reason for their choice of this large heavy-duty unit was the reputation for absolute dependability that has been built up for these rugged Worthington engines over a period of years.

Let's look at some of the time-tested features that insure this dependability:

1. *Heavy cast-iron base and frame.*
2. *Steel forged crankshaft bedded in base.*
3. *Gear-driven camshaft.*
4. *Metal-to-metal fit between cylinder heads and liners.*
5. *Main bearings lubricated at bottom where pressure is greatest.*
6. *4-bolt connecting-rod bearing assembly.*

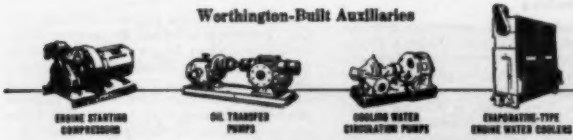
An insurance policy can be no better than the company that backs it. That's why before you buy, it will pay you to look carefully into the manufacturer's reputation.

It is by serving customers such as Kalamazoo that Worthington through the years has built a reputation for manufacturing long-lived, dependable equipment—a reputation that is backed in the heavy diesel field by the *longest experience* of any manufacturer of this type of equipment.

Feel free to call on Worthington for further details on diesel performance. We can meet all your engine requirements—oil, gas, or "dual fuel". Contact Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.

E1.4.

Worthington-Built Auxiliaries



Economical Continuous Power—Diesel Engines, 150 to 2,640 hp . . . Gas Engines, 190 to 2,880 hp . . . Dual Fuel Engines, 150 to 2,640 hp.

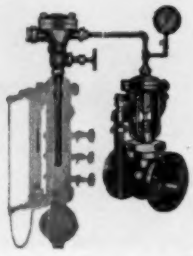
IN LOUISIANA

An ATLAS representative writes as follows about boiler troubles in a Louisiana sawmill. After solving the difficulties he says:

"Each boiler was supplied with a

CAMPBELL
Boiler Feed Water Regulator

—in which no floats, thermostats, or generators were involved in the design or construction. A continuous blow-down feature was incorporated in the unit."



He concludes:

"The plant now has ample dry steam, with more excess fuel than can be burned under the boilers."

Users of the CAMPBELL Like These Six Points:

1—Continuous Blowdown;

2—No Moving Parts;

3—No Thermostats;

4—No Floats;

5—No Links;

6—No Generators.

The CAMPBELL has been controlling all types and sizes of boilers for many years—SUCCESSFULLY. Note the INDICATING GAGE (shown above) which can be placed on the switchboard or control board, showing what the regulator is doing at all times.

Slightest changes in water level cause the CAMPBELL to operate the largest control valves instantly. Rugged. Efficient. Economical. No fine adjustments. Easy to install. 50 to 400 lb. pressure and up.

Sizes 1" to 8". Guaranteed by a concern that has been in the regulating valve business EXCLUSIVELY for more than a half century.

Using the coupon below will save time

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

287 SOUTH ST., NEWARK 5, N. J.

Represented in Principal Cities

☐ Without obligation, please send data on the CAMPBELL Boiler Feedwater Regulator. Also, please send complete information on the following ATLAS products:

☐ Damper Regulators	☐ Oil Control Cocks
☐ Temperature Regulators	☐ Humidity Controllers
☐ Exhaust Control Systems	☐ Thermostats
☐ Pressure Regulators	☐ Balanced Valves
☐ Pump Governors	☐ Control Valves

Name .....

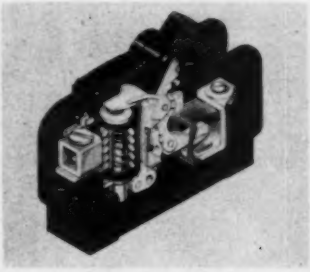
Firm .....

Address .....

New equipment and developments

(Continued from page 27)

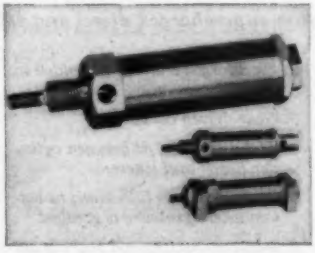
overloads, the breaker provides for a time delay; at ten times the rated current or short circuit conditions it trips instantly. Arc extinction is provided by a quenching well. Principle application is in panelboards



handling lighting and appliance circuits, and as a built-in combination start-stop switch and overload protector. It is available in single pole 120 v a-c (15 to 60 amp) or two pole 120/240 v a-c (15 to 35 amp) units.

29—Cylinders feature varied adapters

Interchangeable mountings are the feature of the Web-Aire cylinder announced by Web-Aire Products Div. of H. G. Weber & Co. Particularly adapted for jig, fixture



and tooling operations, it is available with foot mounted and clevis mounted adapters. It has a threaded piston end, and steel head with interchangeable bronze bushings. Standard strokes are 1, 2, 3, 4 and 6 in., with other strokes and special rod ends made to order.

30—Steam cleaner is fireless

Kelite Products, Inc., announces production of their High-Volume Fireless Steam Cleaner. This steam cleaner hooks into existing steam lines, thereby utilizing steam which has been generated for other purposes in the plant. This cleaner is a high-volume unit; the two models affording capacities 150 or 250 gph. Only two connections are necessary, one to the steam source and another to an electrical outlet. The caster-mounted unit can be moved to any work area where steam cleaning is required. With the positive action Kelite steam cleaner pump (110 v or 110-220 v a-c), dry steam is introduced into the gun along with precise

amounts of the cleaning compound. The patented Hy-Vel nozzle concentrates the cleaning blast within a small, well-defined area. Standard equipment includes patented Aerated Gun Grips, which insulate the steam gun and permit the operator to work without the necessity for gloves.

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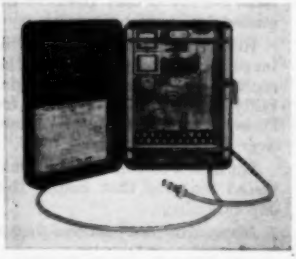
31—Device detects flame failure

Combustion Control Corp. introduces a Fireye photoelectric flame failure safe-guard for the protection of semi-automatic or manually fired gas, oil, and combination gas-oil burners. When flame fails, Fireye instantly cuts off fuel and can be wired to sound an alarm. Fireye system FP-4 consists of electronic control type 26SJ5 and Firetron Scanner type 48 PT1. The scannner contains the Firetron tube, a photo-conductive cell that "sees" all flames and gives instan-



taneous and positive response to flame failure. Extremely compact, the scanner is installed in a short length of standard ½ in. pipe located where its sensitive cell can scan the flame area. The type 26SJ5 control is housed in a dust-tight steel case, and contains power supply and relay system. The housing is mounted on the control panel and plug-in construction of the chassis provides

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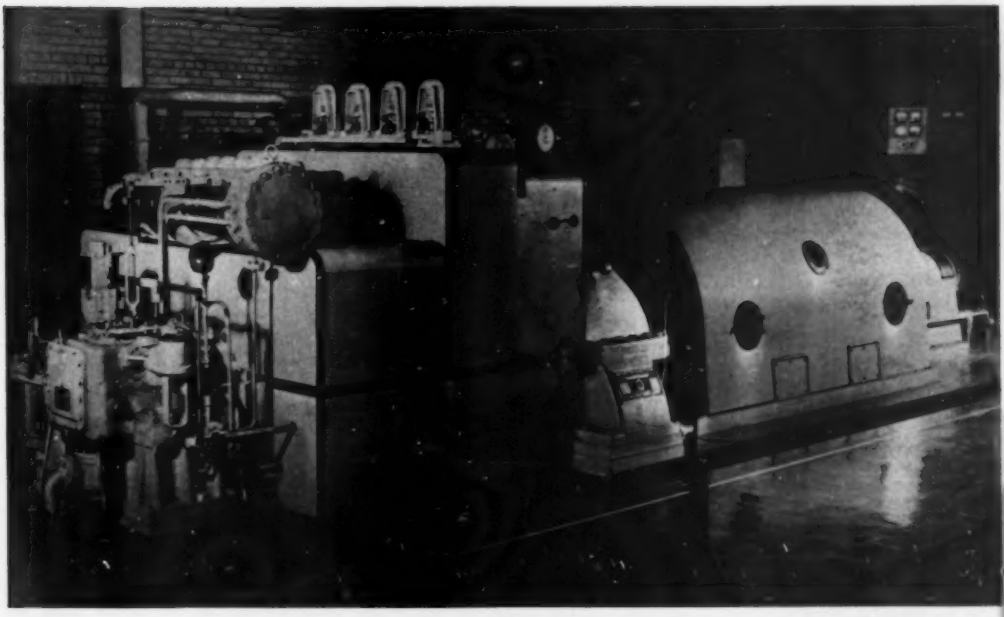


Story of an Economy Drive

How the Worthington Steam Turbine Pays Dividends for the City of Litchfield

What happened at Litchfield, Minnesota, is a clue to a most economical power plant operation.

Originally, the Litchfield municipal power plant consisted of low-pressure boilers, a steam engine and a small turbine-generator unit. The exhaust steam is sold for municipal heating.

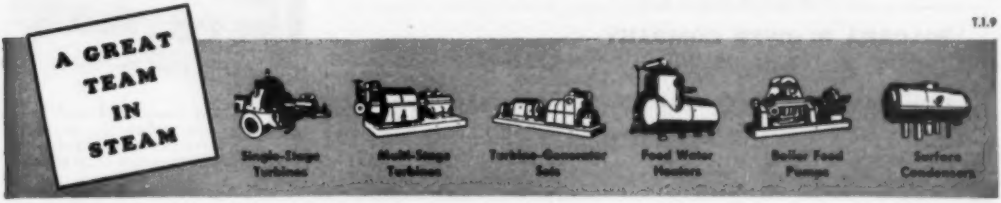
Next—a Diesel engine-driven generator was installed. The load grew, and finally, after a careful survey, it was decided to install a 3000-kw Worthington turbine generator and automatically extract steam for heating purposes.

Worthington builds steam turbines in all types and sizes—and turbine-generator sets up to 10,000-kw. For proof *there's more worth in Worthington*, call our nearest office or write to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.

WORTHINGTON

STEAM TURBINE GENERATORS

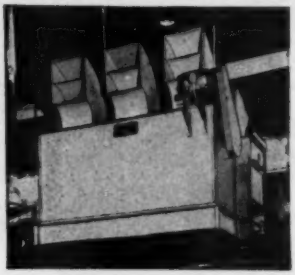
T.I.9



New HIGH PRESSURE STEAM Fan Heater

Gives Savings You Never Had Before

The first heater to make High Pressure Steam really trouble-free and practical in plant heating. Every engineer should understand its original method; write for Niagara Bulletin and performance data.



HOW IT OPERATES: — A dual coil system makes use of all heat, both sensible and latent. High pressure steam enters the upper coil, shown on the diagram below. Its condensate drains into a trap. Then this high pressure condensate is released into the header of the lower coil. It instantly flashes into steam at vapor pressure.

Any high pressure condensate that remains liquid is carried to the vapor condensate return header by a drain tube that also gives off its heat into the air stream.

The vapor condenses in the lower coil. Its condensate is kept at a high level in the return leg by a wier in the return header so that all its heat is made useful and it is sub-cooled by contact with the coldest air entering the heater. Vacuum condensate return to boiler is vapor free.

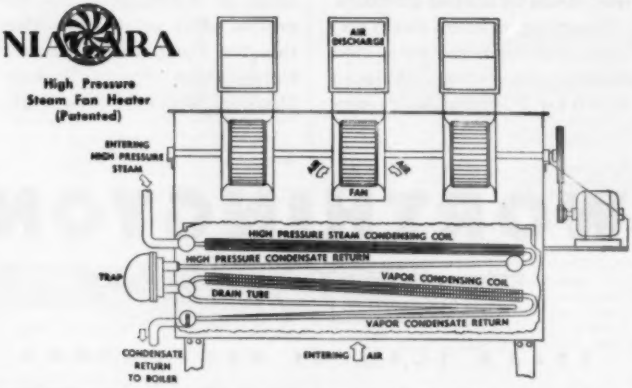
HOW IT SAVES IN COST: — Piping is much simpler and less costly than in low pressure systems. Much secondary piping, traps and big valves are not needed. Pipe sizes are smaller.

HOW IT SAVES IN OPERATION: — Waste is prevented. Every BTU goes where you want it. No dump traps or hot wells waste live steam.

HOW IT SAVES IN UPKEEP: — Condensate flow is even, vapor free, easily handled. No sudden surges of condensate in starting. No hammering, no hard wear and tear on system. Properly engineered for the job, final air temperatures are not excessive; heat easily directed where needed; no flashing of low pressure condensate. Heaters are self-draining on shut-down. Heaters are strongly built; all coils including the condensate drain tubes are hairpin bend, stress relieving. Use thru four heating seasons has proven these advantages in large scale plant heating.

NIAGARA

High Pressure Steam Fan Heater (Patented)



NIAGARA BLOWER COMPANY
Dept. IP, 405 LEXINGTON AVE., NEW YORK 17, N. Y.

Please send Bulletin 109 on the Niagara High Pressure Steam Fan Heater.

Name .....

Address .....

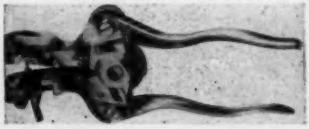
New equipment and developments

(Continued from page 144)

for simplified replacement and maximum accessibility for examination or adjustment. Fail-safe circuits assure instant shutdown upon the failure of any component within the equipment.

32—*Stripper prevents wire crushing*

A heavy duty, automatic wire stripper has been announced by Wood Specialty Manufacturing Co. Known as the Speedex Auto-



matic 766-I, it features a delayed action release which prevents the wire from being crushed or bent. The entire action is automatic; squeezing the handles causes the

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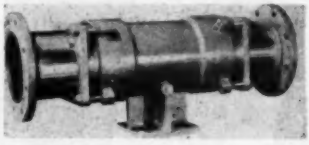
stripper to grip the wire, cut the insulation and strip it free in one operation. Especially designed for industrial and heavy duty use, it has a cutting blade made from a special steel alloy for long life. It strips solid as well as stranded wire from 8 to 22 ga and by changing blades it can be used to strip parallel wire, 300 ohm TV and FM twin transmission wire.

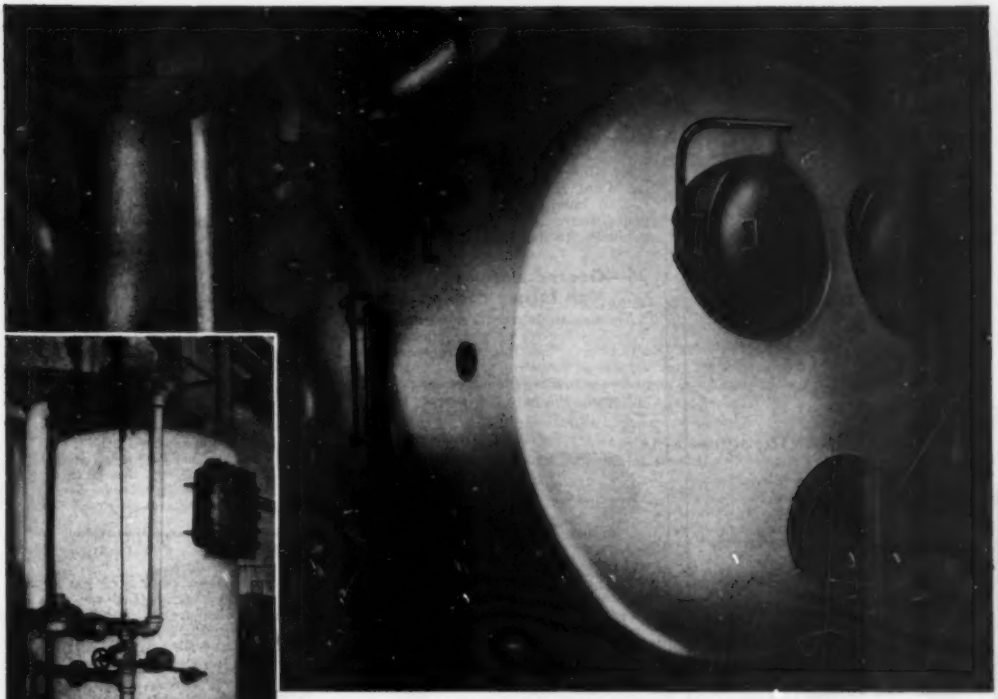
33—*Expansion joints internally guided*

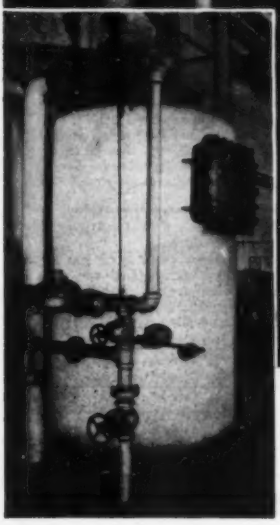
A line of internally guided slip type expansion joints has been introduced by The Royalton Co. Both single and double joints in 150 and 300 psi steel are offered in sizes



from 3 to 20 in. Bases are optional in the single joints and standard in the double joints. Ends beveled for welding and service connections can be supplied in all sizes and

(Continued on page 148)





A Big Help

on small—as well as big—deaeration jobs

Small deaerators are big business at Worthington! That's why the plant with small-capacity requirements will benefit by getting acquainted with the complete range of Worthington deaerating equipment.

Worthington Gives You All Types, All Sizes

Worthington deaerating heaters and deaerators are built in sizes to handle from a few thousand pounds an hour to over a million. They are tailor-made to fit the particular requirements of each job. Special designs are available for operation with scale-forming water.

Both tray and steam-jet types are made—with external surface-type vent condensers or internal direct-contact vent condensing. They can be furnished for any practical operating pressure—constant or variable—or for vacuum operation.

With a complete range of sizes and types at their fingertips, Worthington engineers can competently recommend the design best suited to *your* requirements.

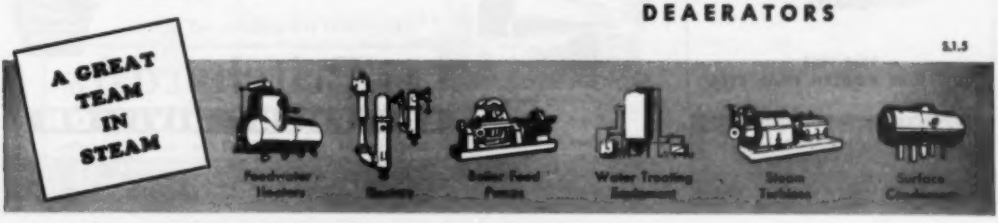
Remember, too, Worthington designs are backed by over 50 years experience in the design and manufacture of direct contact feedwater heaters and over 100 years experience in hydraulic machinery.

Send your water treating problem to Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N. J.

WORTHINGTON

DEAERATORS

S1.5



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ALBANY LUBRICANTS

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- Pressure Greases
- Graphite Greases
- Ball & Roller Bearing Greases
- Gear Lubricants
- Rope Dressing
- Penetrating Oils
- Automotive Lubricants

METAL WORKING

- Cutting Oils
- Grinding Compounds
- Cutting Compounds
- Grinding Oils
- Soluble Oils
- Forging Compounds
- Tempering Oils
- Rust Preventives
- Quenching Oils
- Spinning Lubricants
- Die Lubricants
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ELECTRICAL DIVISION

- Albany RBR Wire Pulling Compound
- Paraffined Cheesecloth Rolls
- Stearine Candles & Flux

Send for Recommendation Charts

1868-1952
BUT MORE MODERN THAN EVER

ADAM COOK'S SONS, Inc.
Mfrs. of Albany Lubricating Products
LINDEN, NEW JERSEY

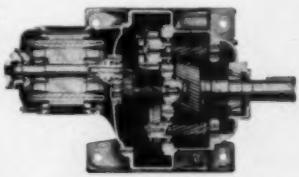
New equipment and developments

(Continued from page 146)

types. Slips for 4 in. traverse are standard, but 8 and 12 in. traverse per slip can be had. A bronze guide ring and chromium plated sleeve insure proper guidance and minimum friction.

34—Geared motor has high torque rating

Through triple reduction gearing in their Type GM Syncrogear, U. S. Electrical Motors offer a high torque, low speed motor capable of ratios up to 175:1. By the use of two secondary pinions driving the output gear, the effective torque rating is



doubled. The load is distributed equally between the two pinions by a splined herringbone pinion. Consisting of a high-speed motor with torque-multiplying, built-in gearing, the unit reduces the amount of space necessary to house this type drive. Available in 1 to 10 hp with speed ranges of 5 to 25 rpm, the Type GM has features of normalized castings, asbestos-protected windings, solid centricast rotor and Lubriflush lubrication.

35—Steel and copper is lead coated

Announcement is made by Knapp Mills, Inc., of availability of two metals designed primarily for sulphuric acid resistance. Ferrolum is steel with an inseparably bonded lead coating, which combines the strength of one with the acid resistance of the other. Cupralum is a lead clad copper which retains the electric conductivity and heat transfer value of copper along with the lead's acid resistance. Among the applications for these metals are: use with sulphuric and other acids; electroplating anodes capable of handling up to 1000 per cent increase in current over lead anodes; protective and processing equipment for use in nuclear industries.

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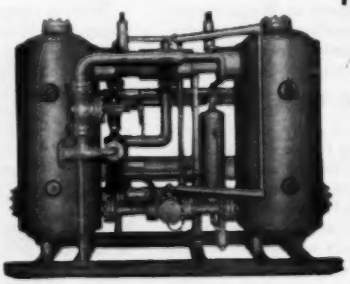
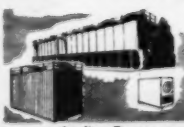
It's UNEXCELLED FOR DEPENDABLE DEHYDRATION!

The Quality Pritchard
HYDRYER*



The Quality Pritchard HYDRYER* is *unexcelled* for dependable dehydration of air and other gases for instrument and process controls. Dual adsorbers provide continuous drying action. HYDRYER* is standard, packaged unit designed to reduce dew points to minus (−) 40°F. Only service connections are required. Specially designed HYDRYER* units can be tailored to meet your individual requirements.

*Registered Trade Name



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Gas & Air Treating
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How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

The old packing gives the clue to most packing failures...

I was ruined by shaft misalignment. When old packing shows excessive reduction in cross-section directly beneath rod, shaft or plunger, bad alignment is indicated. Leakage usually occurs around top of shaft or rod. Cause may be worn bearings which permit shaft to whip.

Too much gland pressure did me in. Badly deformed rings next to the gland follower, with bottom rings in fair condition, suggest excessive gland pressure or improper installation. Excessive gland pressure sometimes causes packing to extrude between follower and rod or shaft.

Lack of lubrication made things too hot for me. If the wearing faces of the rings are dried out or charred, with the rest of the packing in usable condition, the trouble probably is lack of lubrication. Excessively high operating temperatures and wrong type of packing can cause similar symptoms.

I'm worn out because I turned with the shaft. Unusual wear on the outside circumference of the packing almost always indicates one of two conditions. The rings may be binding on the shaft and rotating with it, or the packing is too loose in the stuffing box and moving with the rod.

Why you can count on Johns-Manville

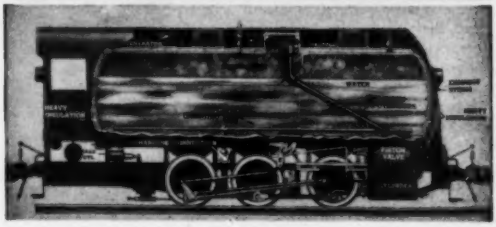
INTERLOCKED ROD PACKING

Because it's braided square, not braided round and pressed square, J-M Interlocked Packing lasts longer . . . has a better contact area . . . makes a tight seal with medium gland pressure. J-M Interlocked is recommended for both reciprocating and rotating service, for use against steam up to 500°F; hot and cold fresh and salt water; oils; weak acids and caustics.

Your distributor will help, too! Your J-M Packing Distributor can help you take the guesswork out of packing problems. He carries complete stocks of Johns-Manville quality packings and can supply you promptly. For the address of the J-M Packing Distributor nearest you, write Johns-Manville, Box 290, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS



Steam is injected through the charging pipe. Energy is stored in the form of heat, in the water. Charging requires from ten to thirty minutes, depending on the steam pressure, and can be done during idle periods.

If you have steam available in your plant, then a Porter Davenport-Built Fireless Locomotive can save you up to 50% in haulage and switching costs. This is a challenging statement that has been proven in hundreds of important industrial installations.

Porter Fireless Locomotives are made in all sizes from 10 to 100 tons, either geared or direct drive.

Particularly valuable is the fireless—smokeless—noiseless feature wherever the locomotive operates indoors, wherever fire or explosion hazards exist and where avoidance of smoke, soot and dust is a MUST. Avoidance of noise is appreciated almost everywhere—a soft exhaust is the only noise when a Porter Fireless is used.

DAVENPORT LOCOMOTIVES

Available in
STEAM
FIRELESS
GASOLINE
DIESEL
with
ELECTRIC
or HYDRAULIC
or MECHANICAL
DRIVE

PORTER
Davenport Built
LOCOMOTIVES
Established 1866

WE ANALYZE YOUR NEEDS

Conditions of service should be given full consideration so that the locomotive may be designed to meet the requirements. Our engineers will gladly study your operating conditions and range of work—and then submit reliable recommendations as to type and size of locomotive. No obligation whatsoever.

WRITE US TODAY

and find out about the remarkable benefits which await YOUR use of fireless rail haulage.

DAVENPORT LOCOMOTIVE Division
DAVENPORT BESLER CORPORATION
DAVENPORT IOWA, U.S.A.

EXPORT OFFICE — 30 CHURCH STREET NEW YORK 7 — CABLE ADDRESS: BESSLER

Spot news

(Continued from page 118)

proximately 30 per cent water, along with a certain amount of sulfuric acid and salt not completely removed by washing. To dry the crumb, eight inclined heavy-duty conveyers were installed to carry it from the filter to the floor above and through ovens held at about 175 F.

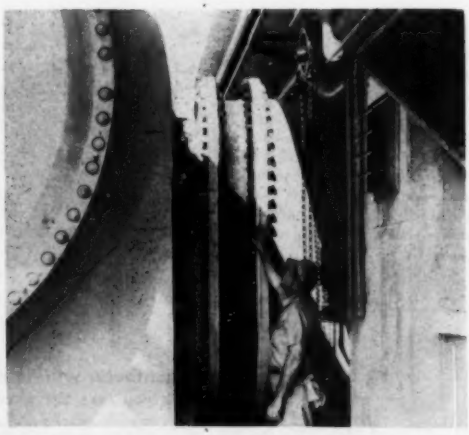
The corrosive conditions under which the conveyers must operate — high humidity plus the presence of acid and salt — made corrosion-resistant stainless steel a logical choice of construction material. The conveyers each consist of 173 hinged flights of perforated 16-gage type 316 stainless steel. The sections are approximately 12 in. long and 115 in. wide. Plant engineers have found that in addition to corrosion resistance, the flights easily withstand the mechanical flexing inherent in this type of conveyer.

V-Belts Get "Incubator" Treatment During Manufacture

Industry has come up with an "incubator" treatment for manufacturing industrial V-belts for power transmission. An entire B. F. Goodrich factory devoted to rubber V-belt manufacture is humidity-controlled. The area is sealed from all other operations to maintain an even moisture content.

Company engineers say the reason for the unique plant layout is the tendency of rayon and other fibers and fabrics to absorb moisture. These fibers form the internal muscles of rubber V-belts. Where moisture content of the air varies from day to day, belt fibers absorb different amounts of

(Continued on page 153)



***HUGE EXPANSION JOINT AT HOUSTON LIGHTING & POWER** This rubber and fabric expansion joint, 8 ft high 21 ft wide and 1 ft face to face, was recently installed in Green's Bayou Station, Houston, Tex., by the United States Rubber Company. The joint, between steam turbine and condenser, compensates for different rates of expansion and isolates vibration*

BIRD-ARCHER'S COMPREHENSIVE 8 POINT WATER TREATMENT SERVICE

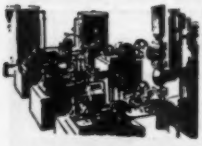
Even if your present water treatment methods appear satisfactory, it will pay you to look into Bird-Archer's 8-point water treatment service. Any or all of this comprehensive, efficient service is available to you. Talk to your Bird-Archer representative about it next time he calls. Or, write us now to arrange a consultation. No obligation, of course.

What Bird-Archer Does

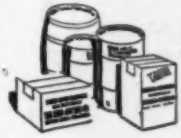
1. Surveys Plant—Bird-Archer makes a complete study of plant operation involving the use of water or steam . . . checks present equipment and past performance.

2. Studies All Available Water — Starting at the source, Bird-Archer makes exhaustive analyses of water supplies.

3. Develops Treatment and Control Systems—On the basis of these comprehensive studies, Bird-Archer develops a complete system of treatment and control, including necessary operational changes.



4. Specifies Equipment that May Be Necessary — Bird-Archer determines whether installation of additional equipment will be helpful . . . analyzes benefits to be derived.



5. Furnishes Proper Chemical Treatments When Required—For more than a half century, Bird-Archer has manufactured specifically formulated treatments to solve individual problems.

6. Instructs Plant Staff—Plant personnel is carefully instructed by experienced technicians in the application of treatment and control . . . teaches simple, accurate test procedures.

7. Makes Periodic Check-Ups—To make certain that the recommended system is providing the best possible results, a Bird-Archer Service Engineer makes regular, personal check-ups.

8. Offers a Laboratory Service for Scientific Analysis—Modern Bird-Archer laboratories, staffed by trained chemists, specialize in water analyses and research...check accuracy of plant control.

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FOR YOUR PROTECTION

"TEST HOSE TO FOUR TIMES SPECIFICATIONS" is standard procedure with every length of Atlantic flexible metal hose.

17 rigorous torture tests for flexibility, bursting pressure and uniformity reveal any material or fabricating fault. That's why Atlantic flexible metal hose is Job Tested & Guaranteed to Do Its Job!

Seamless & Interlocking Hose. Bronze, steel, stainless steel. ⅛"-36" I.D. with proper fittings.

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STEAM SPECIALTIES

Replace Obsolete Steam-Wasting Units With Illinois Specialties

Equip your radiators with smooth-acting Illinois Supply Valves and sensitive, steam tight Illinois Thermo Traps.

Improve system operation by replacing thermostatic drip traps with Illinois Float and Thermostatic Traps wherever rapid elimination of condensate is essential.

Illinois Float and Thermostatic Traps are made in three Series to meet a wide variety of applications and for operating ranges from 50 pounds pressure to 25 inches vacuum.

Investigate! Compare! Try Illinois Traps on your worst service and be guided by results!

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ILLINOIS ENGINEERING COMPANY

INCORPORATED 1909

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SELF -CONTAINED -CONTROLLED -SUFFICIENT -RELIANT

Stacon Temperature Regulator*

The patented Farris Stacon Temperature Regulator is easily the most independent regulator available today. It's unique. It stands alone. It's trustworthy. It needs no watching. It's perfect for the man who wants no cause for worry . . . who wants to relax in the sure knowledge that his temperatures are constant.

Here's why Stacon stands alone in the field. It has no packing glands to leak or bind . . . the stem moves freely. The liquid in the bulb flashes to vapor in the power bellows, assuring hairtrigger response to move the disc. It operates with unbelievable accuracy—to within plus or minus 1 degree—and it operates with that accuracy under *all* conditions. Stacon provides air-operated accuracy at low, self-operated cost.

Get the details on the one truly outstanding temperature regulator—Stacon. Send for Bulletin 50-1000 to get all the details.

*Patented and Patents Pending

Farris Stacon Corporation

533 COMMERCIAL AVE. PALISADES PARK, N. J.

Give 'em the BUM'S RUSH!

Don't let Dirt, Dust, and Grit spoil the working efficiency of your machinery and equipment. Rush 'em out of every crack and crevice with a CLEMENTS-CADILLAC blower-suction cleaner. Easy to use, economical. Ask your mill supply dealer.

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ASK YOUR MILL SUPPLY DEALER OR WRITE US FOR DATA

Spot news *(Continued from page 150)*

moisture during manufacture. Such belts shrink or stretch unequally when in storage or in use, do not match each other in length when used in sets. Control of humidity at the factory eliminates this problem.

Coal Handling Problem Solved Using Industrial Porcelain Enamel

The coal handling problem in the Trenton plant of the Thermoid Company was solved by the application of industrial porcelain enamel which is becoming much more widely known since high temperature and highly acid-resistant porcelain enamels have been perfected.

The original problem revolved around the feeding of anthracite coal, often in a wet condition, from an overhead supply across the face of five boilers by gravity chute to individual hoppers and screw conveyers.

The problem was two-fold. First, the pitch of the gravity chute from the coal bunker to the screw conveyer level was not sufficiently steep to assure good flow of wet coal over an ordinary steel surface. Second, wet anthracite, particularly where it laid in contact with steel parts for long periods of time, produced sulphuric acid and created a serious problem of corrosion to steel parts.

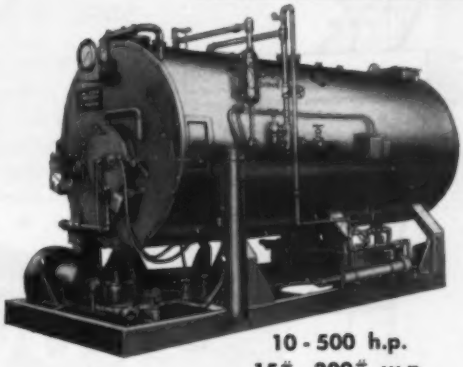
Actually, the second problem was attacked first — that of reducing corrosion damage to the screw conveyers. Working with The Erie Enameling Company, a special formula of acid-resisting, high gloss porcelain enamel was developed and applied to both the conveyer screws and housings. Actual operating experience with the porcelain enameled conveyer screws and housing proved an extended service life and a reduction of horsepower as compared to other types of coatings, according to the plant engineer.

The original conveyer set-up had relied upon bucket conveyers to carry the coal to the main bunker, from which it was distributed to individual coal hoppers by screw conveyer and later fed to the fire-box by another screw conveyer. In order to by-pass this long screw conveyer feeding from the main bunker in case of bunker repairs or other problems, it was decided that a gravity chute extending from the delivery end of the overhead bucket conveyer system across the face of the five boilers was a necessary precaution. The elevation did not provide enough pitch to assure gravity delivery of wet coal over a steel chute surface. The simple addition of a standard porcelain enamel coating, which had been developed for coal chute purposes, made such a chute practical even at the reduced pitch.

It is said that porcelain enamel is not widely enough recognized in many kinds of industrial applications. The material is actually very similar to glass except that it has been developed especially to bond integrally with a steel surface. Hence, nearly any steel part used in industry which needs any of a great many forms of protection might profit by the addition of this inorganic coating. Characteristically, porcelain enamel offers varying degrees of acid-resistance and general resistance to most forms of corrosion resulting from many chemicals, dampness and electrolysis. It is abrasion resistant and often out-wears ordinary steel in abrasive service. Some types withstand heat up to 1800 F and unusual amounts of thermal shock and physical abuse.

AMESTEAM GENERATOR

KNOCKS OUT HIGH STEAM COSTS!



10 - 500 h.p.
15# - 200# w.p.

OIL . . . GAS . . . OR OIL-GAS Combinations

★

FUEL — Guaranteed 80% Efficiency

LABOR — Minimum Attention Required

★

WATCH FOR ME NEXT MONTH . . . MEANWHILE WRITE FOR BULLETIN 1011-C

AMES IRON WORKS

BOX J-1 OSWEGO, N. Y.

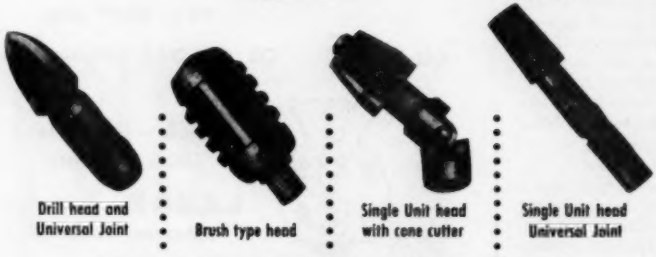
Builders of Better Boilers since 1848

Manufactured under License in Canada by VOLCANO, Ltd., Montreal, P. Q.

for cleaning those MIGHTY IMPORTANT small tubes"

AIRETOOL'S line-up of midget cleaners provides you with just the right tools for safe, quick, thorough scale removal from condenser, heat exchanger and all other small tubes.

Expanding blade type head with #29 motor



Drill head and Universal Joint

Brush type head

Single Unit head with cone cutter

Single Unit head Universal Joint

These cleaning heads can be used with either a flexible drive or universal joint for removing scale or other deposits from straight or bent tubes. Tube sizes range from 5/8" to 2" I.D. Midget motors are powerful and are air driven.

By using them regularly, you reduce down-time and add to the life and usefulness of your valuable equipment. To learn the full story, write The AIRETOOL Mfg. Co., 318 S. Center St., Springfield, Ohio.

BRANCH OFFICES:
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Philadelphia
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Houston
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Baton Rouge

THERE'S AN AIRETOOL TUBE CLEANER AND TUBE EXPANDER FOR EVERY TYPE OF TUBULAR CONSTRUCTION

New bulletins and catalogs

(Continued from page 34)

scribes the operation of transmitter and receiver, and shows photographs and diagrams to illustrate the mechanism and installations. Suggested applications for instrument include measurement of flow of liquids and gases through Venturi tubes, nozzles or orifices; flow over weirs, through Parshall flumes and Kennison nozzles; proportional control of chemical feed, pump control, and liquid level measurement. Builders-Providence, Inc.

CO_2 Recorder **237**

Informative 12-page booklet 51-1008 features CO_2 recorder constructed for boiler plant use. Includes illustrations and discussions on operation of the analyzing and recording sections, component parts and features, and gas sampling systems. The Hays Corp.

HOW TO REQUEST FREE BULLETINS

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Low Resistance Ohmmeter **238**

General purpose low resistance ohmmeters are described in illustrated 4-page folder 24-26. Includes information on calibration, accuracy, testing leads, protective relay, power supply, operating instructions and specifications. James G. Biddle Co.

Regulators **239**

Design advantages of line of pressure and temperature regulators are explained in 4-page bulletin 1007. Sectional view shows the pilot, seats and discs, springs, metal diaphragm and packless construction. Another illustration shows how main valve can be combined with two pilots to form two regulators having different functions. Spence Engineering Co., Inc.

Gages & Thermometers **240**

Large variety of recording, dial indicating, transformer and freezer thermometers and pressure, vacuum and compound recording gages fully described and illustrated in 8-page bulletin G13C. Also 4 pages of operating instructions for recording gages, and complete price list. Electric Auto-Lite Co., Instrument & Gauge Div.

DIESELS

Cooling System Treatment **241**

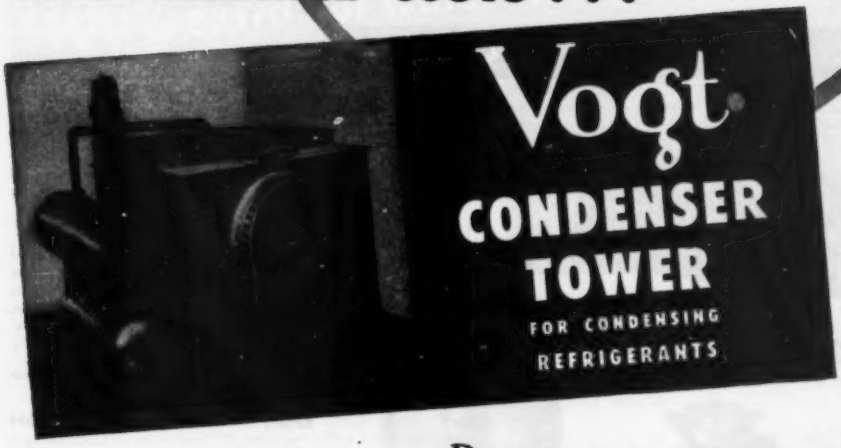
Protection of engine cooling systems through proper water treatment is the subject of 4-page bulletin 5015. Covers

(Continued on page 156)

New

SAVES WATER and CUTS MAINTENANCE COSTS . . .

Illustration shows two views of a 35 ton Condenser Tower prior to partial disassembly for shipment.



SINGLE RESPONSIBILITY:

Vogt, leading builder of refrigeration condensers, assumes responsibility for engineering the unit. Only one purchase order needed.

SHOP FITTED:

To cut down field assembly labor. Requires no cutting or fitting of pipe.

Designed for today's water conservation requirements, and to keep refrigeration costs low, the *new* Vogt Condenser Tower meets the need for a proven, readily cleanable condensing unit.

The Vogt Condenser Tower consists of a multipass straight tube condenser, a receiver, an oil trap, a cooling tower, and a water pump. Removable cast iron heads permit easy cleaning of the condenser tubes.

Water costs are extremely low since the cooling water is recirculated continuously and requires only a small amount of makeup to replace losses due to windage and evaporation.

Condenser Tower units are available in capacities ranging from 5 to 50 tons refrigeration. Additional information will be furnished upon request.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

Cast Your Own Refractory Linings and Shapes of Any Size

SAVE TIME · REDUCE SHUTDOWNS · NO WAITING · CUT COSTS!

MAKE THEM WITH

MOLDIT

REFRACTORY CEMENTS

Simply mix any of the Moldit dry granular cements with water and pour, shovel, trowel or "shoot" into any monolithic shape of any size. No pounding or ramming. Easily patches worn or eroded refractories like new.

There are 7 different Moldits to choose from, each with special advantages with respect to particular applications in furnace walls, baffles, arches, ash pits, stacks, breechings, door linings, etc.

With Moldit you need no stock of special shapes. No worry about slow deliveries. No great skill to install. Any replacement or repair, large or small, can be cast, air cured and put back into service in less than 24 hours.

Moldit Castables are strong at high and low temperatures; no spalling, no shrinkage. They are entirely water resistant and may be safely sprayed or washed. Moldit lasts longer.

Moldit Castables have lower conductivity than firebrick or fire clay linings, are lighter and stronger

Try Moldit—you'll always specify it. Ask for Catalog.

REFRACTORY & INSULATION CORP.

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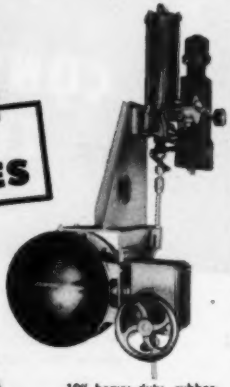
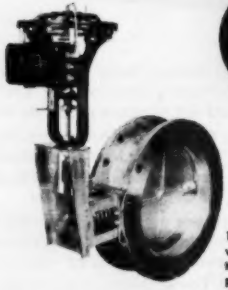
For Air • Steam • Water
Hot • Abrasive • Corrosive
Gases, Liquids, Semi-Solids

Install **ROCKWELL VALVES**



- Manual or Automatic Control and Quick, Tight Shut-Off
- Made of any metal or rubber-lined
- Butterfly, Wafer Butterfly and Slide Valve Types, Threaded or Flanged
- Pipe sizes to 72" and larger



10" heavy duty, rubber-lined steel butterfly valve for 90 p.s.i.; with air cylinder controller and auxiliary clutch and handwheel.

18" alloy steel butterfly valve for 1100° F. operating temperature; with air diaphragm operator and valve positioner.

Write for Catalog and "The Valve News"

ROCKWELL SINCE 1888 BUILT

W. S. ROCKWELL COMPANY

Slide and Butterfly Valves • Steam Traps • Oil Burners

230 Eliot Street • Fairfield, Conn.

New bulletins and catalogs

(Continued from page 154)

the prevention of corrosion of diesel and other internal combustion engines. Gives complete coverage of the necessity for water treatment, chromate control in closed systems, application of treatment and dosages as well as test methods in determining concentrations. Dearborn Chemical Co.

Exhaust Hose **242**

Flexible metal hose for diesel exhaust or intake lines, and misalignment or vibration connections is featured in 4-page catalog CMH-124. Also describes connections for oil, air and fuel lines. Specifications are in table form, and illustrations include cutaways and photos of typical installations. Chicago Metal Hose Corp.

ELECTRICAL DISTRIBUTION

Motor Starters **243**

If you are concerned with motor starters this 8 page brochure presenting a complete line of multi-speed and reversing starters should be a valuable addition to your file. Features listed include small size and light weight. Sizes range from 1 hp at 110 v to 100 hp at 440-550 v. Descriptions and illustrations are arranged for quick reference, and a convenient specification sheet is featured. The Arrow-Hart & Hegeman Electric Co.

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Rotary Packet Switches **244**

Structure, operation and advantages of rotary packet switches are presented in 12-page illustrated bulletin. Shows in detail the many combinations available and provides engineering data, ratings and dimensions. The Arrow-Hart & Hegeman Electric Co.

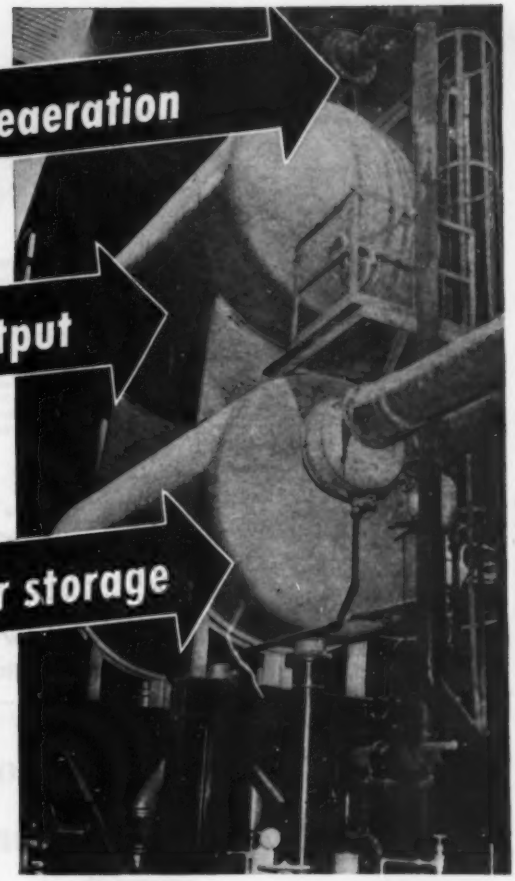
Selenium Rectifiers **245**

Advantages of metallic, dry cell, selenium rectifiers are listed in 4-page bulletin. Supplies a long list of suggested industrial applications for the individual cells in a variety of sizes or as complete stacks. Shows various circuit arrangements and gives cell sizes and ratings. Syntron Co.

Switch & Outlet Boxes **246**

Handy wall chart features switch, outlet and utility boxes. Shows at a glance catalog numbers, sizes, number

(Continued on page 158)



...an example of GRAVER modernizing engineering

When you bring a water treatment problem to Graver, you can be sure of not only authoritative advice and modern equipment design, but more than that . . . *recommendations that consider your pocketbook* . . . the most effective solution at the lowest cost, with savings that may surprise you.

Here's an example.

In 1941, a midwestern steel mill installed a Graver Deaerating Heater, which gave completely satisfactory service for 10 years.

Because of expanded operations and additional boilers, the mill then needed more water heater capacity and storage, and also better quality water. After a careful on-the-spot examination, the Graver engineers incorporated modern internal design to the *existing outer shells* and produced the following results:

	ORIGINAL INSTALLATION	CONVERTED INSTALLATION
Heating capacity	300,000 lb per hr	500,000 lb per hr
Storage capacity	2 minutes	10 minutes
Oxygen in deaerated water	.03 ml per liter	.005 ml per liter

The cost . . . less than 50% of the cost of a new deaerating heater.

Write for advice on *your* boiler feedwater treatment without the slightest obligation and ask for your copy of the new technical article "Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater".

GRAVER WATER CONDITIONING CO.
Division of Graver Tank & Mfg. Co., Inc.
216 WEST 14th STREET, NEW YORK 11, N. Y.

GRAVER

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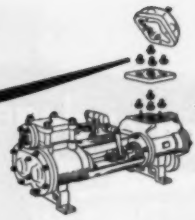
REDUCE PUMP REPAIRS 4 WAYS



1. **Prevent STEM and SPRING breakage.** Exclusive double shock absorber built into Sims valves stops impact shock.
2. **Stop wear.** Long guide of ROTATOR prevents cocking of DISC—assures even opening.
3. **Keep seating surfaces leak free.** Only Sims guarantees the valve DISC will rotate every time it lifts.
4. **Stop valve slam and knock.** Quiet operation is gained by cushioning moving parts and cutting resistance to flow through the SEAT ... with patented **inclined ribs.** This reduction of resistance allows cylinders to fill completely. Pump capacity is increased 20%.

Sims valves are made in sizes from 2¾" to 15¼" to fit any reciprocating pump. Valves supplied ready to install—cast in individual units or in complete plates.

SIMS PUMP VALVE CO., INC.

New catalog shows how Sims valves fit any pump—how they work—efficiency and comparison charts. Send for your free copy today.

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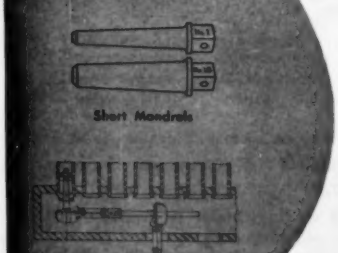
IDEAL

You'll Get More Efficiency with

Series 1500 Tube Expanders

Series 1500



For installation and maintenance of tubes in drums, headers and similar water tube boilers.

A combination of short mandrels and right angle gear drive speeds up operation and assures efficiency with far less operator-fatigue. The new and smaller reinforced gear drive enters most hand-holes.

See Your Dealer or Write Us Today!

THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

New bulletins and catalogs

(Continued from page 156)

and sizes of conductors permitted in each box. For convenience each item in chart is illustrated. Reverse side of chart lists advantages of the units. General Electric Co., Construction Materials Div.

ELECTRICAL INSULATION

Flexible Conduit **247**

Having trouble protecting electrical wiring against moisture, oil, chemicals, corrosive fumes, etc., or vibration and movement? Bulletin C201 on flexible liquid-tight conduit may help solve your problem. Tells advantages and shows installation photos covering various applications. Engineering and installation data included in the 4-page folder as is table of standard sizes. The American Brass Co., American Metal Hose Branch.

HOW TO REQUEST FREE BULLETINS

Each paragraph in this section is numbered —beginning with number 200. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out, and mail. Our Reader Service Department will handle your request promptly.

FUELS & FIRING EQUIPMENT

Combination Burner **248**

Do you purchase gas on an interruptable or curtailable basis? Gas and combination gas and oil burners are featured in a 4-page brochure AD-101 that states any type of gas can be utilized. The combination burner also burns No. 5 oil. Capacity from 16 to 190 bhp. Booklet is informative and well illustrated. Cleaver-Brooks Co., Hev-E-Oil Burner Div.

Burners **249**

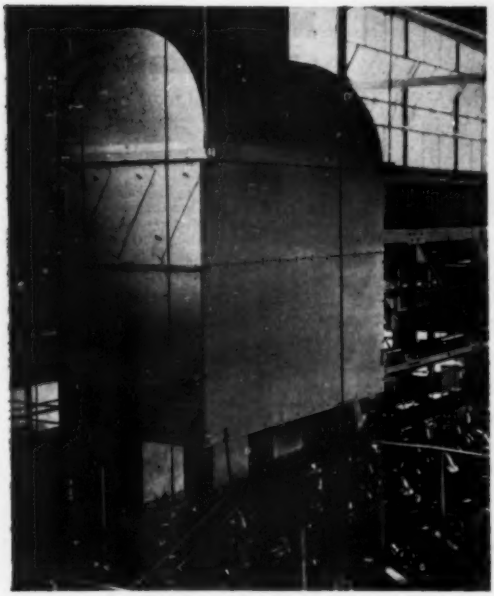
Information on burners for light and heavy oils and for the various gases in popular use is contained in 16-page bulletin. Discusses the burning of various fuels and then shows how the "dry" atomization principle makes for efficient combustion. Drawings and photographs along with descriptive matter show some arrangements possible with basic, stock models. On-the-job photographs included. Lammert & Mann Co.

HEAT EXCHANGER EQUIPMENT

Tubes & Plates **250**

Engineers responsible for the selection of materials in steam power plants will find an expanded 44-page edition of "Tubes and Plates for Condensers and Heat Exchangers" particularly valuable. In addition to application and installation data, booklet also discusses

(Continued on page 160)



Factory Area . . . Cold Room . . . Cafeteria . . . Press Room . . . Lockers

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Whatever your problem may be in industrial heating and air conditioning, it can be effectively solved with products from the complete Trane line.

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In Cold Rooms—A research center maintained by a large manufacturer's association makes tests under many different climatic conditions. Trane Climate Changers with humidifiers are used to supply air at just the right moisture content and temperature for each desired testing condition.

In Cafeterias—To heat the large open area of its modern new cafeteria, an eastern dye manufacturer required attractive cabinet type heating units with the capacity of unit heaters. Efficient hidden heating was supplied by Trane Force-Flo Heaters recessed in the knotty pine wainscoting.

In Press Rooms—Newspaper presses operating at high speed fill the press room with an ink mist. A metropolitan newspaper used Trane Centrifugal Fans for the rapid and efficient change of air.

In Locker Rooms—Employee locker rooms in this modern factory presented a heating problem because the high lockers hindered the even distribution of heat. Year-round comfort is maintained by Trane Projection Unit Heaters with Louver Cone Diffusers. The warm air is spread out along the ceiling, and gently forced down between the lockers.

Whether it's factory areas, cold rooms, cafeterias, press rooms or locker rooms, Trane heating and air conditioning serves everywhere in industry.

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In Press Rooms—Trane Centrifugal Fans are compact, quiet, economical and efficient air handling units that are ideal for heating, ventilating, air conditioning and a great number of industrial applications.

In Locker Rooms—Trane Projection Heaters with Louver Cone Diffusers allow completely flexible control of all the air. Many diffusion patterns, from horizontal blanket to vertical shaft, may be obtained.

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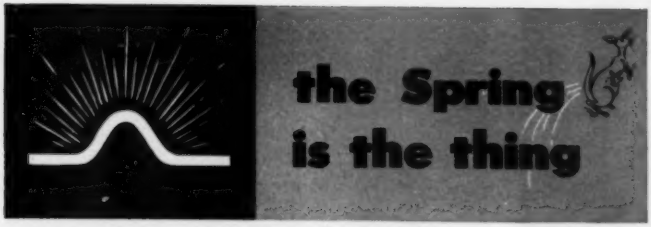

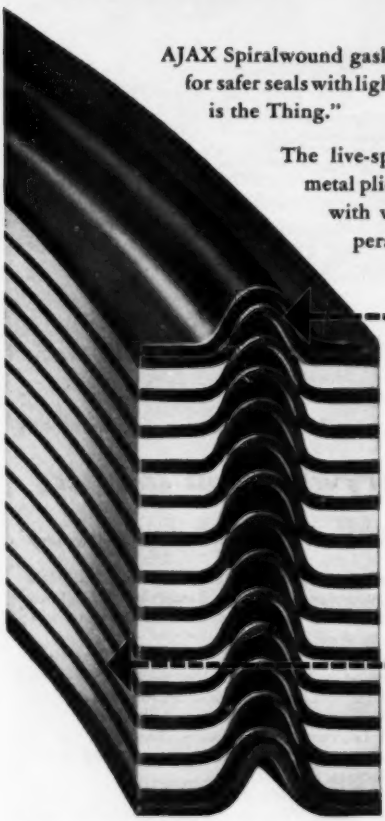

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LEADING FABRICATORS OF "TEFLON" FOR THE CHEMICAL, PROCESS AND ELECTRONIC INDUSTRIES

UGS

New bulletins and catalogs

(Continued from page 158)

operation and corrosion factors affecting tube life and service. Also valuable information on compositions of alloys, and tables on physical and tensile properties, working stresses, weights, and a convenient conversion table. The American Brass Co.

Heat Exchanger **251**

Simple method of controlling the temperature of liquid or gas is explained in 4-page folder 120 on heat exchangers. Cutaway drawing illustrates how the unit operates. Flow diagrams portray how controls keep a fluid at uniform temperature. Lists numerous applications in various fields. Typical installation photographs included. Niagara Blower Co.

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Water Heater **252**

Catalog 60, 12 pages, features instantaneous water heaters and other industrial fluid heating units; illustrates typical installations; and gives useful sizing data, steam consumption tables and diagrams. General Fittings Co.

INSTRUMENTS FOR MEASURE OF ELECTRICITY

Volt Ammeter **253**

Eleven case histories which have been gathered into 16-page manual 504 should make servicing jobs easier. Show how pocket-size a-c volt ammeter saves time and effort in locating trouble. Contains working drawing of the unit with its specifications and mechanical dimensions together with instructions for reading the instrument. Pyramid Instrument Corp.

Telemeters **254**

Instrumentation data sheet 9.1-10 describes G-E telemetering systems and their use with Brown ElectroniK recorders in providing measurement of system variables plus wire speed transmission to central locations. Describes telemetering requirements, fields of application, basic equipment required and the operation of both frequency and torque balance type telemeters. Illustration shows basic layout of the various components of both types. Also illustrates how electric load generation and interchange can be measured at any point in a utility system and recorded at a central location. Minneapolis-Honeywell Regulator Co., Brown Instruments Div.

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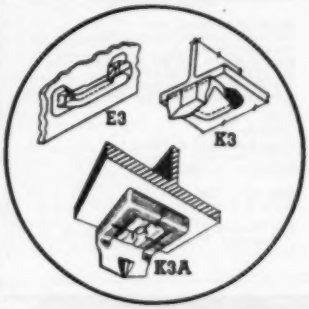

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INDUSTRIAL WASTE TREATMENT

"Industrial Waste Treatment" reprints still available, free of charge 1 to 5 copies; 6 to 25 copies—25c each; 26 to 50 copies—20c each; more than 50 copies—15c each.

For your reference file, following reprints free of charge:

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"Boiler Houses Are Not Necessary Evils", February, 1950.
"Willmar, Minn., Increases Capacity of Municipal Power and Heating Plant", April, 1951.
"Cooling System Layouts for Best Diesel Performance", September, 1951.
"Diesels in A Hydroelectric System", June, 1950.
"Caribou Diesel Plant Built in a Hurry", February, 1950.
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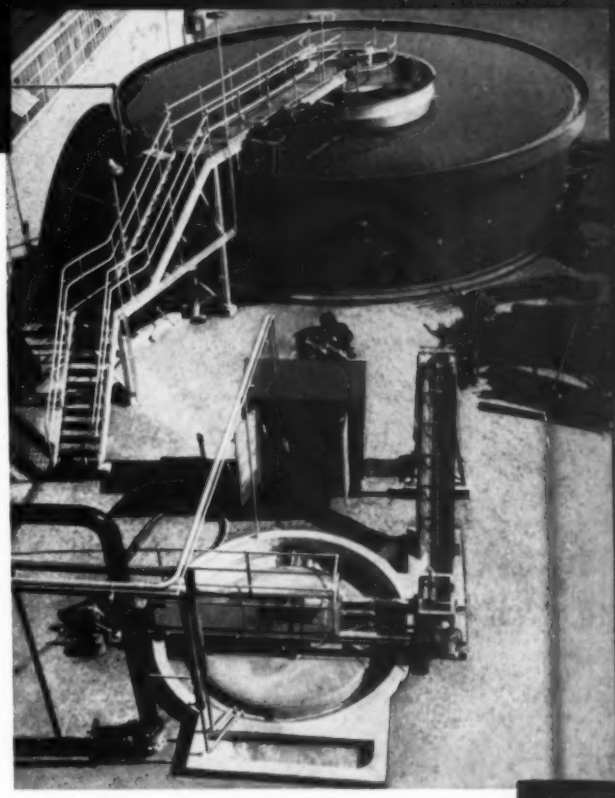

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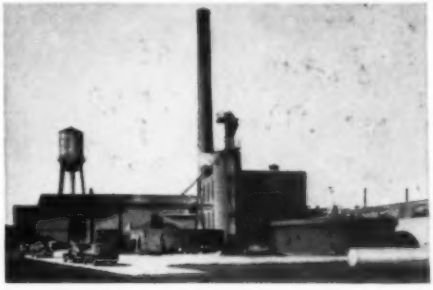

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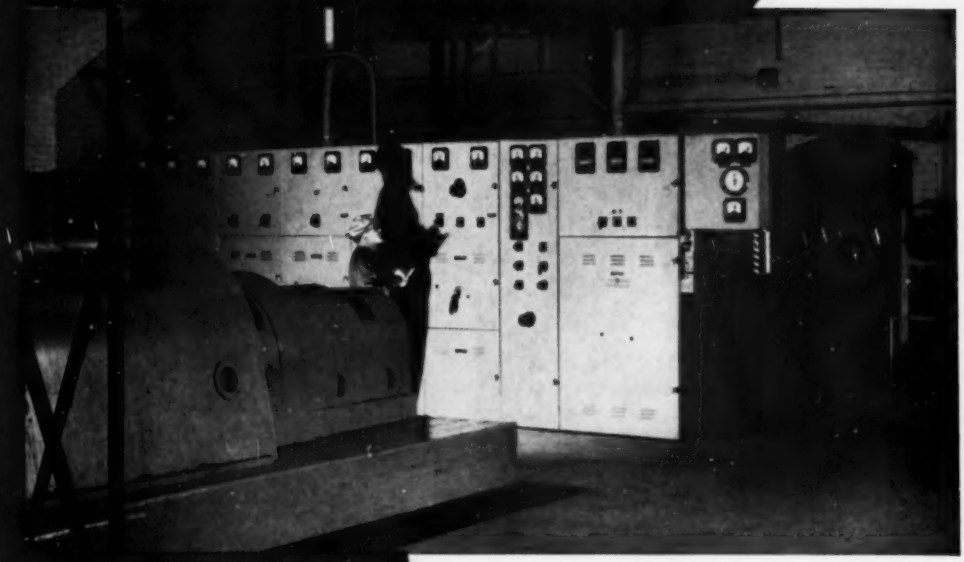

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